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INDIA—A LIFESCAPE

BUTTERFLIES

of

PENINSULAR INDIA

KRUSHNAMEGH KUNTE

Editor

Madhav Gadgil

Foreword

Prof. E O Wilson

INDIAN ACADEMY OF SCIENCES

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SHOUT
SHARE
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Dedication

To Thomas Reid Bell,

who stands tall in the course of Indian natural history
as an inspiration and a challenge . . .

Time has come, the Sailer said,
to sing of scaly wings,
Of Blues and Browns, of Tigers, Crows,
of Pansys and Four-rings,
Of the silver flash on Mormon's wings
And the way a Wanderer swings!

— *Madhav Gadgil*

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PROJECT LIFESCAPE

Our roots are deep in the woods,
Among the mosses, close to the springs,
Our spirits soar high in the sky,
Among the birds and butterflies.

Madhav Gadgil,
after Emil Galle, c. 1884

This book on butterflies of peninsular India represents the first fascicle to be published under Project Lifescape. This project is a part of the initiative of the Indian Academy of Sciences to enhance the quality of science education. It aims to publish illustrated accounts of 1,500 Indian species (and higher taxonomic categories such as orders and families) of micro-organisms, plants and animals. These accounts are meant to assist high school, college and postgraduate students and teachers of biology in reliably identifying these taxa. They would also include ancillary information on distribution, ecology and behaviour that would help design field exercises and projects focussing on first hand observations of living organisms. The information thus generated could feed into a countrywide system of monitoring ongoing changes in India's lifescape to support efforts at conservation of biological diversity, as well as control of invasives, of weeds, pests, vectors and diseases. Hopefully, the accounts would also stimulate popular interest in the broader spectrum of India's biological wealth, much as Sálim Ali's books have done for birdlife over the last fifty-eight years.

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Foreword

Systematics, the science of classification combined with the art of identification, is the foundation of our study of the natural history and evolution. And field guides are the door to the study of systematics. As a boy and then a young scientist in the US southern states of Alabama and Florida, long before Harvard, I lived with field guides. For me they illuminated the outdoors like a lamp switched on in a darkened room. With them I could identify the butterflies, snakes, birds, turtles, amphibians, and fish, everywhere I went. Using this knowledge I then made my entry into the professional study of ecology, behaviour, and my favorite subject, entomology. I have been made aware over the years of thousands of other scientists in the US, Europe, and elsewhere in the world who followed a similar track in the early stages of their career.

The Lifescape Series will play a similar role for India. As exemplified in *Butterflies of Peninsular India*, the first fascicle, it should open doors for young naturalists and future scientists, and turn on the light. I confess that even half a world away this little book made me want to visit India just to see its butterflies on the wing.

There is no better instrument to broaden interest in the living environment on the part of the public at large than inexpensive, user-friendly field guides. Once acquired, they provide an endless and virtually cost-free entertainment and an introduction to the biological sciences. Their role as expediters of science and conservation is especially important in tropical countries, which harbor most of the species of plants and animals in the world, including the least studied and most endangered. Recently Costa Rica, through its National Institute of Biodiversity (INBio), has inaugurated its own equivalent of the Lifescape Series. I hope that the two programs, evolved independently on different continents, will inspire a more effective worldwide movement to study and thence to conserve and enjoy the natural world.

Edward O Wilson
Harvard University,
Cambridge,
Massachusetts, USA

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Preface

As a child, I had been notorious for spending all my time chasing dragonflies, butterflies and lizards. Many of my friends attribute my subsequent development into a naturalist to the fact that on several occasions during my childhood I had fallen from trees on my head. However, to be realistic, my childhood experiences did not teach me much beyond catching butterflies.

It was ten years ago that butterflies began to fascinate me in a serious manner. While I was racing down the road like a mad Pune cyclist, which I still remain, a black butterfly hit my chest with a soft '*tuck*'! It was probably stunned out of its wits, so it stuck to my shirt. I would have shoved it off, but could not ignore a pair of yellow brushes jutting out of its abdomen. Surprisingly, the butterfly could manoeuvre and also retract the brushes into its abdomen. So I continued, wondering about this strange butterfly, as I reached the home of my friend Vijay Joshi, my first bird guru, with the butterfly pinched between my fingers (it survived). Then, for the first time I learnt from him that like birds, butterflies are also not all that bad, and they too have understandable names, unlike plants! The butterfly was a male Common Indian Crow, and the brushes were retractable organs it used to spread its specialized scent scales to attract females. After that day, my attention increasingly shifted from looking for birds to looking for butterflies.

Since my early days as an amateur naturalist, I have longed for a handy, illustrated, and at the same time informative, field guide to the butterflies of peninsular India. Surprisingly, a year ago I found myself working towards writing precisely such a book! Now, I present it to you.

This book is targeted primarily at students and amateurs, although it contains many new observations that may also be of interest to the seasoned butterfly-watcher. The initial pages of this book contain necessary information on butterflies which will get the readers started. However, our butterflies are still poorly studied compared to European and American butterflies, and need much research. It is not necessary to be a professional biologist to study butterflies. Even amateur naturalists can address questions related to natural history, ecology and conservation of butterflies in their own areas. And precisely because they come from the area, they are likely to be able to better interpret results of their studies. Thus, I undertook a year-long study of butterflies around Pune city when I was in my first year of B.Sc. My only starting material for this study was a brief introduction to how birds may be studied, incomplete familiarity with butterflies, and no particular guidance—but plenty of enthusiasm. Eventually, the results of that study found their place in a scientific journal. Given that many universities and colleges from western and southern India are close to forests where butterflies can be studied, it will not be difficult for students and teachers to initiate such studies on their own, and help know and preserve our biological treasure trove.

Something should be said about the selection of butterfly species for this Lifescape fascicle. Initially, we had set an upper limit to number of butterflies we would cover in this fascicle, so that it is compatible with the objective of Project Lifescape. Due to this limitation I had to ignore a few locally common or even widespread species such as the Common Imperial, Treebrowns and Monkey Puzzle. Moreover, species such as the Common Palmfly, which are widespread, common and very interesting, deserve their own species accounts. For the sake of completeness, perhaps all the species from peninsular India should have been included in this book, at least under the subheadings "Similar Species". Hopefully, all of this can be given fair coverage in future.

I would like to end this preface with a story of three great naturalists, because I wish I could have spent time with them. They were the legendary T R Bell, who narrated the story

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over 90 years ago, and his fellow-workers: E H Aitken and J Davidson. It is one of my most favourite passages from Bell's series of articles in the *Journal of the Bombay Natural History Society*. This is my favourite story not merely because it involves a fantastic butterfly and three of my heroes, but also because it superbly depicts the thrill of working with butterflies:

> The caterpillar of this most taking insect (Malabar Banded Peacock) was first discovered by the late E H Aitken, that most genial of men and pleasantest of companions, in the year 1894 in the vicinity of Karwar on the sea-coast of North Kanara District. He was one of three naturalists, who found themselves thrown together in the early '90s in that beautiful spot, and forthwith proceeded to work out the life histories of all the butterflies of the surrounding country... the early days were the best for everything was new, and there was unlimited material with which to work. Everyday brought forth something of interest; every expedition was crowned with abundant success. The larva of *buddha* was much sought after at that time, but had eluded discovery for many months of patient search. The food-plant was known; or, at least, it was taken for granted that it must be Tirphal, for the butterfly was noticed constantly flying round such trees. At last E H A..... found a little caterpillar upon a Tirphal leaf and took it home without saying anything about it. He was very excited and hugged the secret to himself from midday until dark that day; but then he could bear the strain no longer and gave it away. There was great rejoicing among the three and every morning, for several weeks after, very tender inquiries were made about its health and progress in growth, or it was inspected with expectant interest. Then one morning it was reported to be ailing and anxiety was great. Next morning it was dead. That was a day of gloom; but the depression resulted in a firm resolve to seek for more caterpillars and the consequence was in less than a week, there were half a dozen of all sizes in the breeding cages. The rest was easy.

This is in the hope that our generation will further this story with promising days spent with the beautiful butterflies. Newer explorations, more natural history....

Krushnamegh Kunte
August, 2000

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Acknowledgements

Many people have contributed to the making of this book, and I am grateful to them all. First of all I should thank Prof. Madhav Gadgil for trusting my field experience and giving me the opportunity to write this book. However, putting together my observations and available information on peninsular Indian butterflies was not enough. Harish Gaonkar personally checked, and in some cases corrected, scientific names of butterflies and their authors, relieving me of all taxonomic troubles.

K Gunathilagaraj (Tamil Nadu Agricultural University, Coimbatore), Jaffer Palot (Zoological Survey of India, Calicut) and E Kunhikrishnan contributed five species accounts, for which they have been individually acknowledged at the end of their species accounts. R J Ranjit Daniels, Gauri Gadgil, Kumar Ghorpade, S Karthikeyan (WWF India, Bangalore), Chandini Rao (Universities Press), Niranjan Shukla and Peter Smetacek have taken great pains to review and edit the text both technically and gramatically, and I really cannot find appropriate words to express my gratitude towards them. Very early drafts of the text were read in parts by Bhaskar Acharya, Shailesh Deshpande, Shiva Dubey, Avanti Mallapur and Manu Mathai, whose suggestions helped me set the style of writing.

Harish Bhat, Utkarsh Ghate, Sivan V V and Suresh H S have been a constant source of plant-related information. Revathi Murugesan provided secretarial help. My special thanks to Sanjeeva Nayaka ("*Chhotte*") for supplementing the text with his beautiful illustrations. Most of the illustrations were done by him, a few by Sapna Metrani, K A Subramanian and myself. The photographers: Ajit Joglekar, S Karthikeyan, Isaac Kehimkar, E Kunhikrishnan, P Pramod, Niranjan Sant, Sanjay Sondhi and K A Subramanian, have generously provided good pictures in return for very little remuneration. Prof. K Vijayraghavan (Director, National Centre for Biological Sciences, Bangalore) kindly permitted the use of microscopes in his lab to take photographs of butterfly scales. Aadish Dani and Vinay Singh helped in taking these pictures.

Asad Rahmani, Naresh Chaturvedi and Isaac Kehimkar (Bombay Natural History Society, Mumbai) have encouraged me since my early days as a birdwatcher. This included permitting me to consult the butterfly collection at the Bombay Natural History Society, where Vithoba Hegde's assistance was also indispensable.

At the Universities Press office in Hyderabad, working with Madhu Reddy (Director, Universities Press (India) Ltd) and his team: Chandini, Deb, Murali and all the others, has been very pleasurable.

And lastly, I would like to express gratitude towards my family, particularly my mother, who let me develop the way I wanted to during the initial years of my college life, which, as I realize now, is a rare privilege.

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How to use this book

This book gives the natural history accounts of 76 butterfly species. The species are arranged according to their families, and each is given a serial number. This number is referred to in the sections "Key to the Identification of Butterflies" and "List of Species". After the English name of the butterfly, the plate number and serial number of the photograph where that butterfly is depicted are given in parenthesis.

For currently valid scientific names, I have followed Harish Gaonkar's systematic list of butterflies of the Western Ghats. In the case of a few species accounts, following these names are names in parenthesis, which are the names used in Wynter-Blyth's book. I mention these because his book has remained the most popular book with amateurs, and mention of those names may aid in easy referencing.

Natural history information of butterflies is arranged under smaller sections, each section with an appropriate title. Under the section "Similar Species", I have given necessary but only non-technical description of butterflies which look similar to the species for which a particular account is written. If the similar butterflies are depicted on colour plates, the names of those species are followed by plate numbers and serial numbers of photographs, in parenthesis.

Black-and-white drawings under the species accounts illustrate various characters on undersides and uppersides of butterflies, and also males and females if they look very different from each other. Uppersides and undersides of butterflies are indicated by 'UP' or 'UN', respectively. Similar-looking species are also illustrated here for direct comparison with other species. The illustrations are marked with pointers, which highlight the most important identification characteristics of butterflies or their early stages.

Each colour plate is given a serial number, and there are a total of 31 colour plates. Of these, 7 appear in between the introductory sections and species accounts of butterflies, and depict phenomena discussed in the introductory sections ("Introductory Plates"). The other 24 plates ("Identification Plates") appear in between the species accounts and the Appendices, and these have the photographs of the butterfly species discussed in the book. On the colour plates, the numbers which appear before the captions are the serial numbers of the photos. All the species on the identification plates are arranged in the order in which they appear in species accounts; except that mimetic species are arranged with the species that they mimic. Wingspan ranges (sizes) of the species are given in parentheses. "p.—" are page numbers on which identification features of the species depicted will be found.

The butterfly species in Appendix 1 are arranged according to their families, and they follow the same order as in the text. However, the plant names in Appendices 1 and 2 are arranged alphabetically, so that finding them is easier. In Appendix 1, page numbers appear at the end of the list of larval host plants of the butterfly species, and these numbers represent the page numbers on which the description of the butterfly starts.

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Key to the Identification of Butterflies

This table, adapted and expanded from Wynter-Blyth's book, provides hints to aid in identification of the butterflies for which natural history accounts are written in this book. The key identification features of similar species can be found in the accounts of the main species.

When an observer encounters a hitherto unseen butterfly, it would be helpful to note down the following information:

i) whether the wings were tailed, toothed or the apex was produced (see glossary).
ii) were there any markings at the cell-end or in the cell, whether the wing margins had different markings from rest of the wings, and were the upper- and undersides of the same colour and pattern.
iii) the way the butterfly flew.

Sl No	Description	Remarks	Name (Species' serial no.)
	Large (75 mm wingspan and above); Tailed		
	MOSTLY BLACK		
1	Body is red. White and red spots on the hind wing.	Flight is slow. Common in gardens.	Common Rose (2)
2	Two white bands on the fore wing, hind wing has crimson-red spots.	Flight is slow.	Crimson Rose (3)
3	A row of cream-coloured spots across the hind wing.	Flight is fast. Common in gardens.	Common Mormon, mimics the Roses (10)
4	Bright green, small spots.	Flight is very rapid. Fond of flowers.	Tailed Jay (6)
5	Wings are dusted green, with a vivid blue-green patch on the hind wing.	Found in the forests and scrub.	Peacocks (12 & 13)
	MOSTLY WHITE		
6	Tails are very long and pointed. Has black border and stripes.	Found in dry forests, occurs only in summer.	Spot Swordtail (7)
	Large; Tailless (or Hind wings toothed)		
	MOSTLY BLACK OR DARK BROWN		
7	Hind wing is mostly golden. Huge in size.	Flight is leisurely.	Common Birdwing (1)
8	Hind wing is pale blue. Very large in size.	Found along the forest paths and streams.	Blue Mormon (11)
9	Yellow spots and an irregular band on the wings.	Flight is fast. Common around habitations.	Lime Butterfly (9)
10	A blue-green band on the wings. Fore wing without marginal spots.	Flight is very rapid.	Common Bluebottle (4)
11	A light blue band on the wings. Fore wing with marginal spots.	Flight is very rapid.	Common Jay (5)
12	Bluish-white markings.	Flight is of medium speed.	Blue Tiger (43)
13	Striped white. Marginal cream-coloured spots on the hind wing.	Similar in appearance to the Blue Tiger.	Common Mime (8)
14	Two rows of marginal white spots on the wings.	Flight is slow.	Common Indian Crow (46)
15	Triangular white marks and marginal cream-coloured spots on the wings.	Similar in appearance to the Common Indian Crow.	Common Mime (8)

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Sl No	Description	Remarks	Name (Species' serial no.)
16	Big oval white patches on both the wings.	Found in wooded areas, sits at prominent posts.	Danaid Eggfly, mimics Plain Tiger (42)
		Mostly White	
17	Veins are black, hind wing is yellow with marginal red spots.	Flight is slow, found at tree-tops.	Common Jezebel (18)
18	Numerous black spots. Very large in size.	Flight is slow and floating. Often found in groups.	Malabar Tree Nymph (47)
19	Pale yellow tinge, narrow borders, with or without a cell-end spot.	Rapid, bounding flight. Found on garden flowers.	Common Emigrant (14)
		Mostly Tawny-Red	
20	Fore wing with white-spotted black apex. 3 black spots on the hind wing.	Flight is slow. Common around habitations.	Plain Tiger (44)
21	Fore wing with white-spotted black apex. Veins are broadly black.	Flight is slow. Found in wooded areas.	Striped Tiger (45)
22	Fore wing with a white-spotted black apex. Prominent black markings. Wing margins are wavy.	Flight is slow. Found in moist forests.	Tamil Lacewing (30)
		Bronze-Green	
23	Large and brilliant. A broad band of white spots on the fore wing.	Found in evergreen forests. Flight is very powerful.	Clipper (35)
		Dark Brown	
24	Fore wing, which may be produced at the tip, with a black eye-spot; hind wing may be toothed.	Found among the leaf-litter, camouflaged. Flight is jerky.	Common Evening Brown (26)
	Medium Size (45–75 mm wingspan)		
		Mainly White	
25	Fore wing with a black tip and a large spot. Hind wing with marginal black spots.	Found at high altitudes. Flight is of medium speed.	Indian Cabbage White (20)
26	Black borders to both the wings. Fore wing with a hockey-stick mark. Underside is yellow, veins are black.	Flight is erratic. Found in open places in dry areas.	Pioneer (22)
27	Black borders to both the wings. Fore wing without a hockey-stick mark. Underside yellow, veins black.	Flight is of medium speed. Found in scrub and dry forests.	Common Gull (21)
28	Wings are unmarked except for a narrow black tip. Fore wings are very narrow. Underside may be faint yellow.	Flight is fast. Common along lush forest streams.	Common Albatross (23)
29	Fore wing with a broad, black tip. Underside is unmarked except for an irregular black band on the fore wing.	Flight is fast. Found along lush forest streams.	Common Albatross (23)
30	Greenish- or yellowish-white with thin borders. Underside is striated with brown.	Flight is fast and zig-zig. Common in dry areas.	Mottled Emigrant (15)
31	Fore wing with a broad orange tip, underside yellow.	Flight is hurried and close to the ground.	White Orange Tip (24)
		Mainly Shades of Brown	
32	Dark brown. Large eye-spot on the fore wing. A white band and eye-spots may be present on hind wing.	Found among leaf-litter in the forests.	Common Bushbrown (27)
33	Fore wing with a black tip and a yellow band. Small black spots present.	Found in moist forests. Very wary.	Rustic (31)

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Sl No	Description	Remarks	Name (Species' serial no.)
34	Lemon-yellow spots on the fore wing. Small eye-spot on each wing.	Perches low, is fond of flowers.	Lemon Pansy (40)
35	Very dark brown-green with darker markings. Fore wing is pointed.	Flight is powerful and gliding.	Common Baron (37)
36	Dark brown with darker markings. Hind wing margin is silvery-white.	Found along forest streams and openings.	Grey Count (36)
37	Large. Dark brown with a green sheen. Fore wing has a series of small white spots.	Flight is powerful and gliding. Associated with mango plants.	Common Baron (37)
38	Dark reddish-brown with fine black lines across both the wings.	Slow, sailing flight. Common around castor plants.	Angled Castor and Common Castor (38, 39)
39	Dark brown with 3 yellow spots on the fore wing. Underside dusted grey.	Flight is powerful. Crepuscular.	Giant Redeye (73)
40	Small. A thin, white band on the underside of the hind wing.	Flight is powerful. Found along water-courses.	Common Banded Awl (62)
41	Small, pale brown, mostly unmarked. Wings are long and triangular.	Flight is powerful. Sits on the underside of leaves.	Brown Awl (63)
42	Large and small semi-transparent spots on the fore wing.	Rests with the wings spread flat.	Common Spotted Flat (64)
	MAINLY YELLOW OR ORANGE		
43	Yellow with black borders or white.	Flight is rapid. Found at high altitudes.	Nilgiri Clouded Yellow (17)
44	Orange. Small, black spots on both the wings.	Found in wooded areas. Quick in its movements.	Common Leopard (32)
45	With a few black spots. Hind wing with a white-spotted black border.	Flight is slow and close to the ground.	Tawny Coster (29)
	BLACK AND WHITE		
46	Black with 3 horizontal, white bands made up of spots.	Flight is sailing. Found in sunny forest *nullahs* and clearings.	Common Sailor (33)
	RED AND BLACK		
47	Pinkish-red with black spots. Fore wing-tip is black with white spots.	Flight is rapid. Found on grassy slopes and in the plains.	Painted Lady (41)
48	Bright reddish-brown with a broad band of white spots on the wings.	Found along forest streams.	Commander (34)
	BLUE AND BLACK		
49	Small. Upperside is a metallic, deep blue. Underside is brown with black spots.	Flight is strong. Fond of damp soil patches.	Large Oakblue (58)
50	Pale blue with black veins and borders.	Flight is fast, wandering. Found in forested areas.	Common Wanderer, it mimics the Blue Tiger (25)
	Small (up to 45 mm wingspan)		
	BRIGHT YELLOW		
51	Borders are black. Underside is marked with small, narrow, black markings.	Flight is weak.	Common Grass Yellow (16)
	WHITE		
52	A large black spot on the fore wing. Underside is striated with light green.	Flight is very weak. Sits with wings closed.	Psyche (19)

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Sl No	Description	Remarks	Name (Species' serial no.)
		Rusty/Chestnut-Brown	
53	Underside is chestnut-brown with a silvery-white spot on the hind wing.	Common in openings in moist forests.	Chestnut Bob (69)
54	Rusty with several large, semi-transparent spots on the fore wing.	Rests with its wings spread flat.	Fulvous Pied Flat (66)
		Dark Brown or Black	
55	Large. Lower half of the hind wing is snow-white.	Rests with its wings spread flat.	Water Snow Flat (65)
56	A very large, curved, white spot on the fore wing.	Found in moist forests with heavy undergrowth.	Restricted Demon (70)
57	Large. Black with large, white spots.	Common in gardens.	Grass Demon (71)
58	Small. Black with small white spots.	Found in grassy areas.	Indian Skipper (68)
59	Wings marked with orange-red bands and spots.	Found in wooded areas.	Dark Palm Dart (75)
60	Small. Small yellow-orange spots on the fore wing.	Found in hilly grasslands. Flight is moderate.	Tamil Grass Dart (74)
		Light Brown	
61	About 5 small, black spots on the hind wing. Upperside is dark brown.	Associated with palms. Flight is strong.	Indian Palm Bob (72)
62	Underside marked with semi-transparent. dots. Upperside is dark	Found in open, grassy areas.	Rice Swift (76)
63	Very small, semi-transparent spots on the fore wing.	Rests with its wings spread flat.	Common Small Flat (67)
64	Underside has a big eye-spot on the fore wing, hind wing may have a series of small eye-spots. Striated.	Hopping flight, close to the ground.	Common Five-ring (28)
65	Tiny. Underside is grey or brown with small, fine, dark brown or black spots. Upperside is pale blue or brown.	Flight is weak. Found in grassy areas.	Tiny Grass Blue (51)
66	Underside with red, black and silver bands. Upperside fore wing has an orange patch.	Flight is very fast. Mostly found close to the ground.	Common Silverline (59)
		Blue Above (but not metallic blue); with thread-like tails	
67	Dull violet-blue. Underside white, with light rusty stripes.	Flight is fast. Fond of flowers.	Pea Blue (54)
68	Dull violet-blue. Underside is white, broadly striped in black. Tailed.	Common in gardens, scrub and riversides.	Zebra Blue (49)
69	Pale violet-blue. Underside is grey-brown with small black spots and dark bands. Two metallic spots.	Flies quickly around bushes, etc. Settles readily on flowers.	Gram Blue (53)
70	Dark slaty-blue. Underside is brown with a thin darker band.	Flight is strong.	Slate Flash (61)
71	Dark violet-blue. Underside is brown with thin, paired, white lines.	Flight is weak.	Common Lineblue (56)
72	Sky-blue. Underside is brown or grey, with white lines or pale brown bands.	Flight is weak.	Common Cerulean (55)
		Blue Above (but not metallic blue); tailless	
73	Tiny. Pale blue or brown. Underside is grey or brown with small, fine, dark brown or black spots.	Flight is weak. Found in grassy areas.	Tiny Grass Blue (51)

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Sl No	Description	Remarks	Name (Species' serial no.)
74	Brilliant violet-blue. Underside is super-white with small, black spots.	Common along forest streams.	Common Hedge Blue (50)
75	Purple-blue. Underside is grey with coarse brown spots. A cloudy brown patch on the hind wing in dry season.	Co-occurs with *Citrus* plants.	Lime Blue (52)
	METALLIC BLUE ABOVE		
76	Underside is grey with a series of black lines. Two tails and black lobes.	Flight is strong. Sits at prominent posts.	Peacock Royal (60)
	MOSTLY WHITE; TAILLESS		
77	Upperside is black with red hind wing. Underside is white with black spots and orange-red hind wing border.	Flight is weak. Common in habitations and rocky areas in forests.	Red Pierrot (57)
78	Upperside is metallic green at the base, black bordered. Underside is spotted black. Tailed.	Flight is weak. Associated with *ber* trees.	Common Pierrot (48)

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1. Introduction

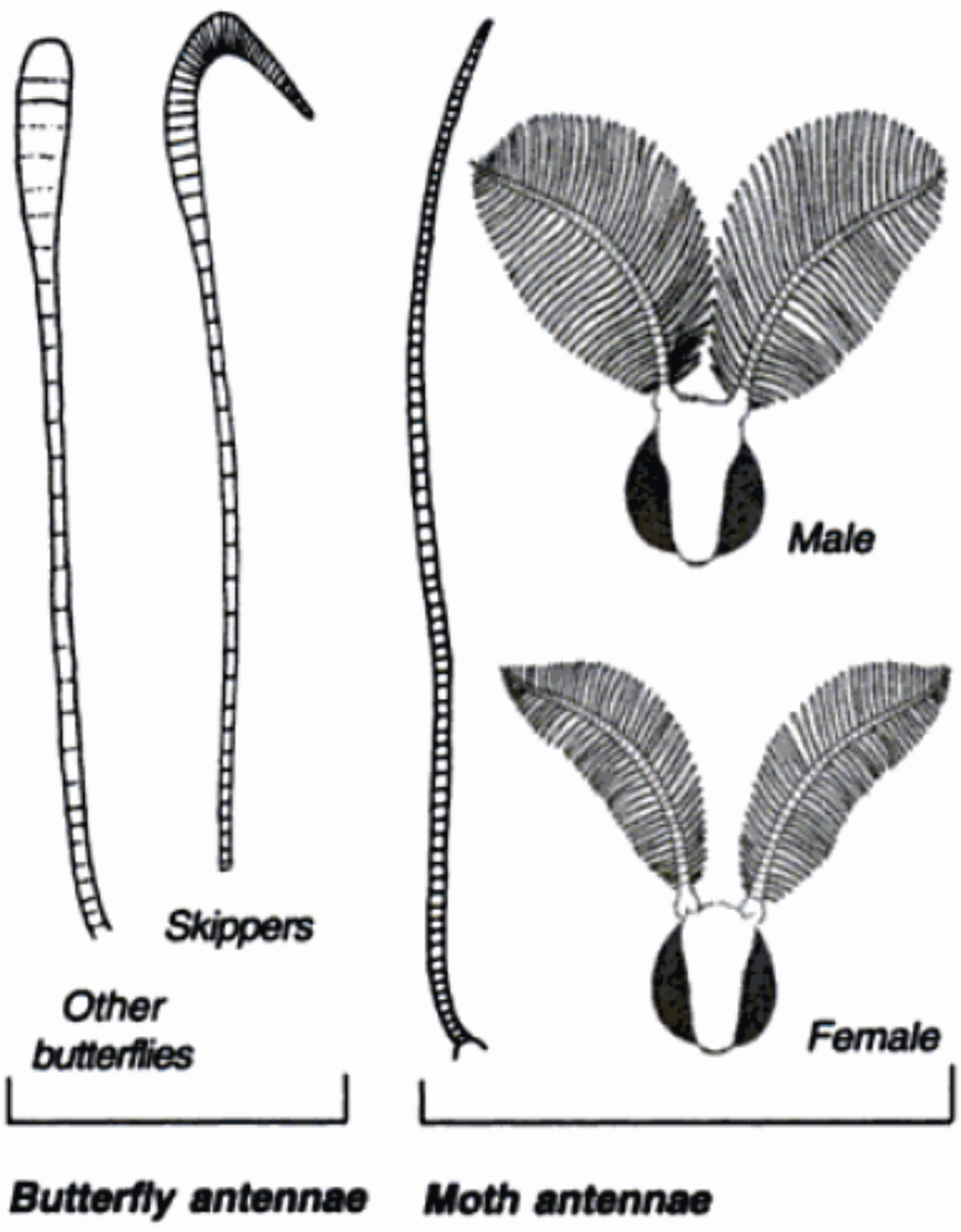
Insects are amongst the most fabulous creations of nature. After all, is there any non-human society as complex and as organized as the legendary termite or ant colony? And how many animals are as colourful as butterflies? The sheer diversity of insects is also mind boggling. Of the approximately 1.5 million known species of animals, plants and microbes on earth, over 800,000 are insects. This species diversity is the result of a wide array of forms and functions that the insects display. There are insects active on land and under water, in deep subterranean caves and on mountain-tops, working their way under the soil and to the top of tall forest canopies. Although their body sizes are small, ranging usually within less than a millimeter to 40 mm, in many terrestrial communities their collective biomass is superior to all the vertebrate animals put together.

Butterflies are perhaps the most conspicuous and colourful of insects. Due to their attractiveness and omnipresence they have acquired a niche in the prose and poetry of various cultures. Their caterpillars can be reared at home and the transformation from caterpillar to butterfly can easily be observed. Therefore, they make excellent subjects for natural history observations and scientific studies. What are butterflies, then?

1a. Butterflies, as a Taxonomist Sees Them Insects, along with crabs, spiders, scorpions, centipedes and millipedes, belong to the phylum Arthropoda (*arthro* = jointed or segmented, *poda* = feet or appendages). The phylum is divided into five classes, and the class Hexapoda (*hexa* = six) or Insecta includes all insects. These are, generally characterized by the following traits: 1) body is divided into head, thorax and abdomen, 2) three pairs of jointed legs, one each on a thoracic segment, and 3) two pairs of wings, borne on the second and third thoracic segments. The most species-diverse groups of Insecta are, in descending order, beetles (close to 350,000 species), butterflies and moths (over 140,000 species) and ants, bees and wasps (close to 120,000 species). Butterflies and moths belong to the order Lepidoptera (*lepis* = scale, *pteron* = wing) and are the only insects with wings covered by scales: the tiny, loosely attached structures that give them their remarkable colours and patterns (Plate 1, no. 3).

1b. Differences between Butterflies and Moths Since butterflies and moths are closely related, identifying them can sometimes be confusing. However, there are a few easy rules by which most species of butterflies can be distinguished from moths:

1. The antennae of butterflies are clubbed, that is, they have a swelling at their tips (Skippers, a group of butterflies, have the swelling before the tip of the antennae). They may be scaly, but not hairy. Those of moths are not clubbed and may be branched or thread-like, sometimes covered with hairy outgrowths. The antennae of the female and male butterflies are similar, but many male moths have more feathery,



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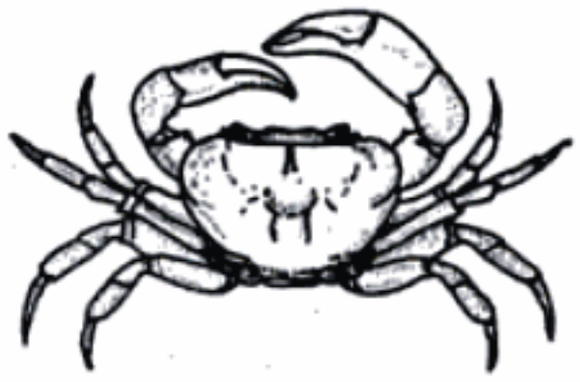
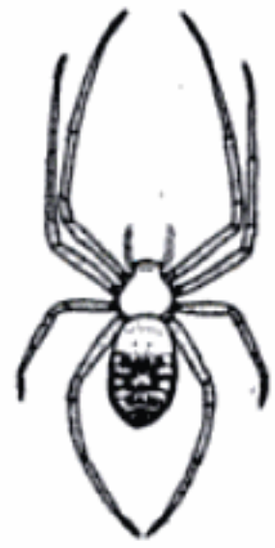
ARTHROPODA ("jointed-legged animals")

Centipede



Crab

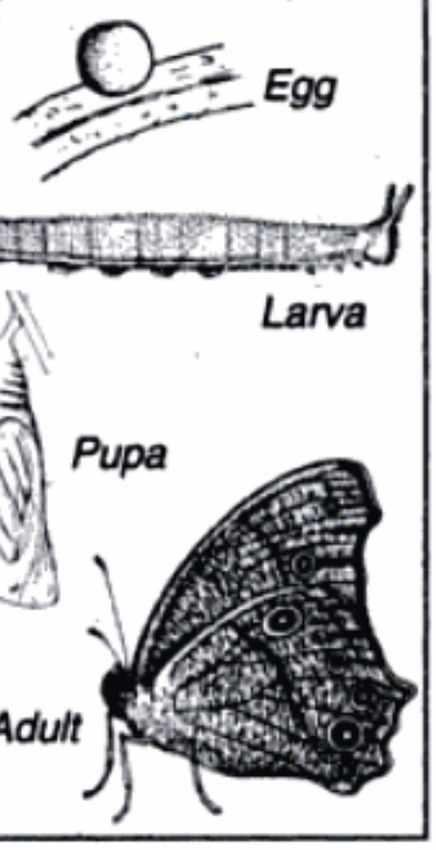
Millipede



Spider

INSECTA (insects)

Complete metamorphosis



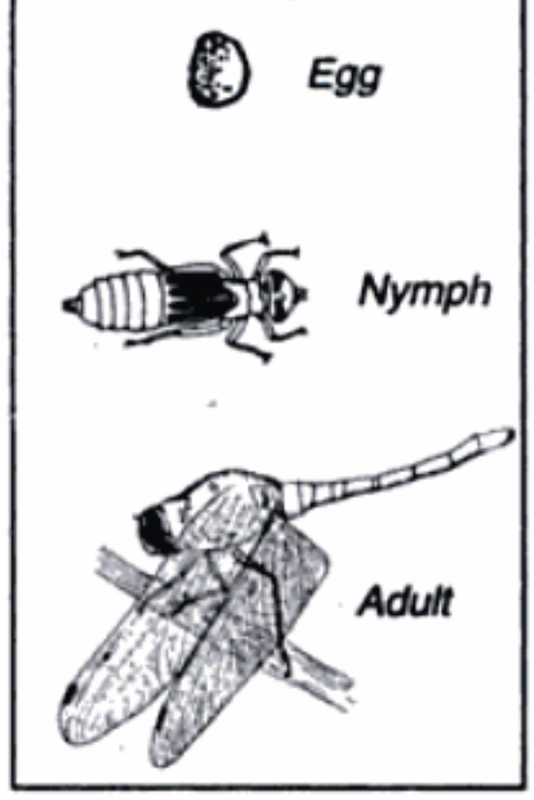
Bee

Beetle

Grasshopper

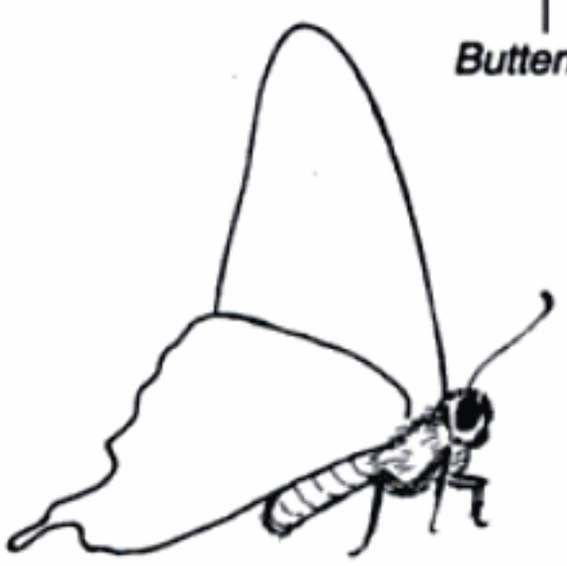
Cockroach

Incomplete metamorphosis



LEPIDOPTERA ("scaly-winged" insects)

Butterflies



Moths

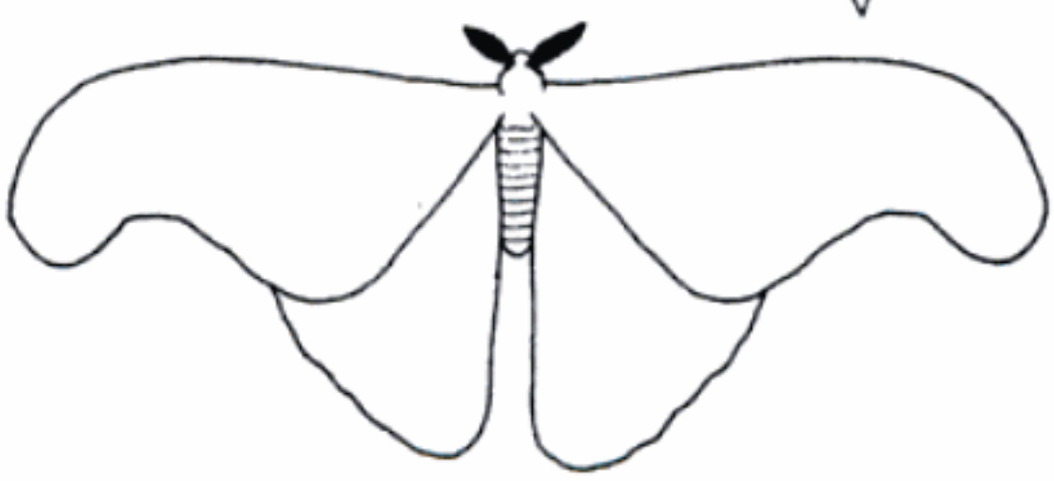


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Table 1 Classification and Diversity of Butterflies

Suborder	Superfamily	Family	Subfamily	No. of Species
RHOPALOCERA (Butterflies) 17,200 spp.	HESPERIOIDEA (Skippers) 3,500 spp.	HESPERIIDAE (Skippers) 3,500 spp.	Pyrginae	20 species
			Hesperiinae	Approx. 60 species
			Coeliadinae	9 species
	PAPILIONOIDEA (all other butterflies) 13,700 spp.	PAPILIONIDAE (Swallowtails) 700 spp.	Papilioninae	19 species
		PIERIDAE (Whites and Yellows) 1,000 spp.	Pierinae	Over 25 species
			Coliadinae	9 species
		LYCAENIDAE (Blues) 6,000 spp.	Miletinae	2 species
			Curetinae	3 species
			Theclinae	45 species
			Polyommatinae	50 species
			Riodininae	1 species
		NYMPHALIDAE (Brush-footed Butterflies) 6,000 spp.	Amathuslinae	1 species
			Satyrinae	Approx. 30 species
			Charaxinae	5 species
			Nymphalinae	46 species
			Heliconiinae	2 species
			Acraeinae	1 species
			Danainae	10 species
			Libytheinae	2 species

Table 1. The species numbers for the suborder, superfamilies and families are for the world . The number of species in the last column are for peninsular India, under respective subfamilies. Only those subfamilies that are represented in peninsular India are mentioned (adapted from Ackery, 1984).

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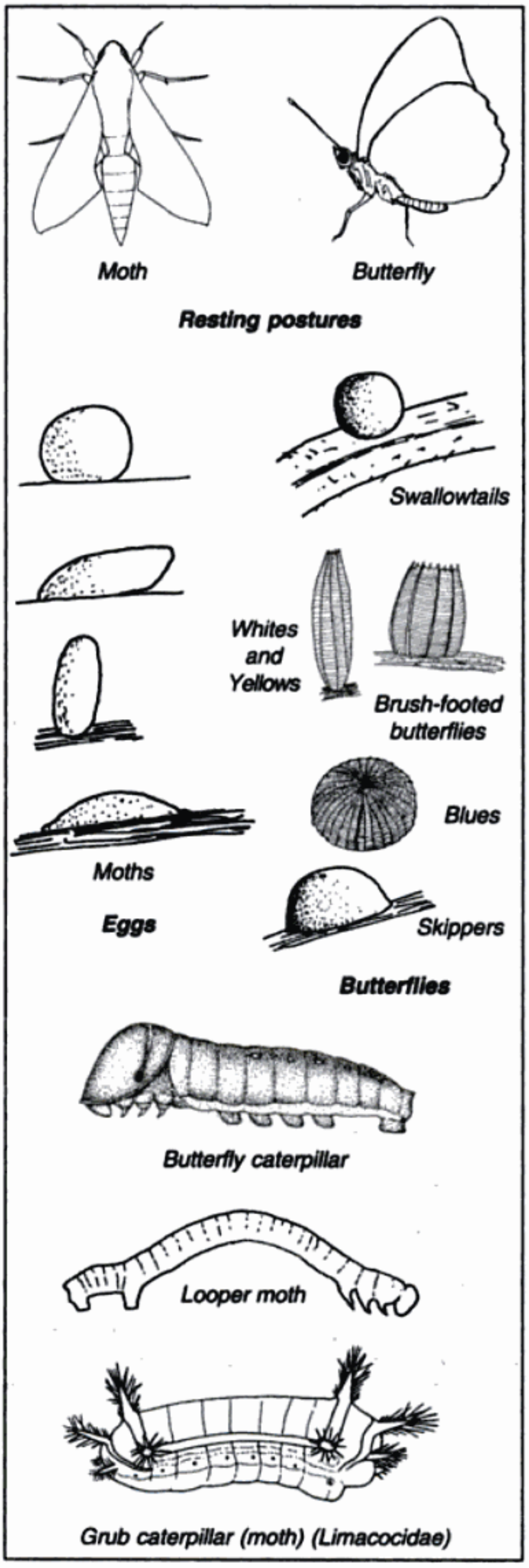
branched antennae (Plate 1, no. 1). Moreover, butterflies always hold the antennae in front of their face, while the moths may hold them close to their wings, or under them along the flanks when they are at rest.

2. At rest, butterflies fold their wings over their backs, holding them erect (with the exception of some Skippers, for example, the Flats). Moths spread them flat, or fold them in the same plane as the body, partly or completely covering the hind wings with the fore wings.
3. Unlike in butterflies, moths have a stiff bristle at the base on the front margin of the hind wing, which fits in a groove or bristles on the fore wing. This holds the two wings together.
4. The waist is more prominent in butterflies and their abdomen is usually thinner. Moths may be bulky, with a less distinct waist.
5. Most butterflies fly by day, moths fly by night. However, a few butterflies, for example, certain Skippers and Evening Browns, are active at dusk and possibly at night. Conversely, there are also day-flying moths.
6. Butterfly eggs are round or bottle-, dome- or disc-shaped and may be sculptured. Moth eggs are round, flat or scale-like.
7. Butterfly caterpillars possess three pairs of true legs, four pairs of prolegs and a pair of claspers (which are also a type of prolegs). All prolegs are present only in the caterpillars. Moth caterpillars may lack between 1 to 4 pairs of prolegs.
8. The spines or hairy structures of butterfly caterpillars never sting, but those of moths may do so (Plate 1, no. 2).
9. Butterfly pupae are supported by strands of silk, collectively forming a 'body-band', or may hang freely. They are usually found on plants, under a leaf or a twig, occasionally among leaf-litter. Moth pupae are not supported by a body-band. They are enclosed in a cocoon, usually placed in leaf-litter or loose soil, or on the bark of a plant. The pupae of Skippers are secured in cells made by the caterpillars from leaves, which are somewhat equivalent to the cocoons of the moths.



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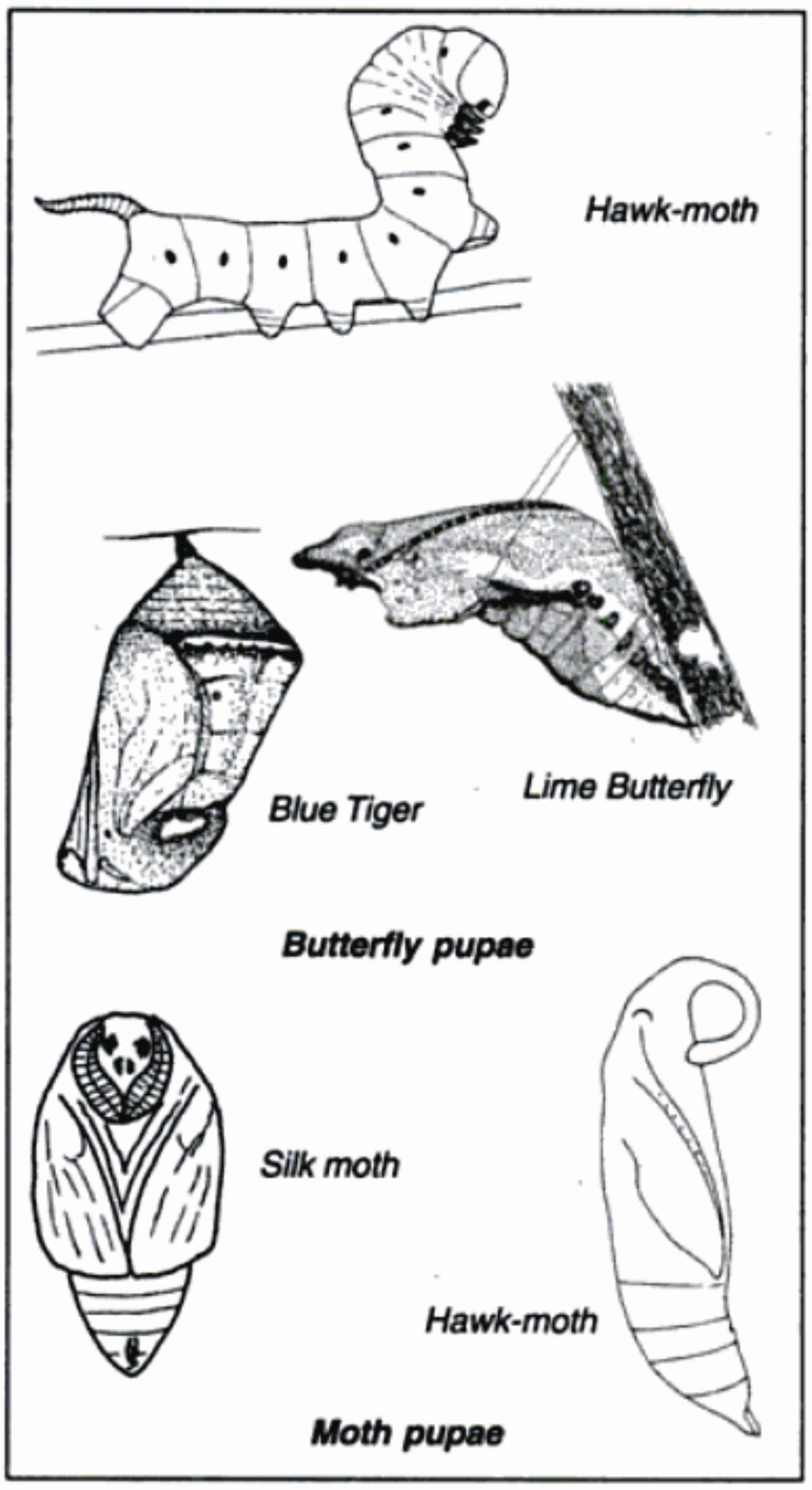

Table 2 Diversity of butterflies in India

Family	*Common Name*	*Diversity*
Papilionidae	*Swallowtails*	*13 genera, 107 species*
Pieridae	*Whites and Yellows*	*20 genera, 109 species*
Nymphalidae	*Brush-footed butterflies*	*98 genera, 521 species*
Lycaenidae	*Blues*	*90 genera, 443 species*
Hesperiidae	*Skippers*	*99 genera, 321 species*
Total		*320 genera, 1,501 species*

1c. Diversity of Butterflies Earlier, butterflies were classified into smaller families and India alone had 9 families. However, many of the older families are now merged into the family Nymphalidae, finally maintaining only 5 families across the world, all of which are represented in India. A recent estimate (Gaonkar, 1996) of the number of butterfly species in India is 1,501. The family-wise break-up of these species is given in Table 2.

Classification and species diversity of peninsular Indian butterflies is given in Table 1.

1d. Life Cycle of a Butterfly (or how an ungainly caterpillar turns into a beautiful butterfly) (Plates 5, 6 & 7) Once upon a time, a caterpillar wreaked havoc in Lord Brahma's garden. As it grew fatter and fatter, the garden lost its lush greenery. Not being able to satisfy its voracious appetite, it finally ate up all the ornamental plants. Outraged by this behaviour, Brahma damned the caterpillar to become an immobile, unattractive pupa. The caterpillar was shocked by this curse and, feeling guilty about its mistake, begged for mercy. Forgiving as he was, Brahma said, "You shall become a pupa, but emerge as a beautiful butterfly." The caterpillar underwent the course and finally became a colourful, winged butterfly…

Although this may not be why the butterfly metamorphoses, this story briefly and correctly narrates life stages of a butterfly. Insects complete their life cycles roughly in two ways. Most produce eggs, of course (females of a few insect species, for example, the tsetse fly, retain them inside their bodies until the larvae emerge or finish their growth). But the new-born cockroaches and bugs are reminiscent of the adults. They grow only in size and later develop wings and reproductive organs, but do not change their body form. The immature and mature stages eat roughly the same food in a similar manner.

Butterflies, moths, beetles and ants, on the other hand, are larvae when they hatch from the eggs, and are quite different from the adults. The larva is the only growing stage in the life cycle and accumulates some crucial

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resources for reproduction. After it attains a sufficiently large size, it pupates. The pupa is the dormant stage. The adult emerges from the pupa after an appropriate period. The adults are concerned mainly with reproduction. Thus, there are four distinct stages in their life cycle: the egg, the larva, the pupa and the adult. Unlike bugs and cockroaches, these insects undergo a 'complete metamorphosis'.

The eggs are fertilized after mating. The female may produce only one or two large batches of eggs that are all laid together (for example the Pioneer), or produce many small batches, which are laid over a period of many days or weeks. In the latter case, the eggs develop slowly and in smaller batches and as newer eggs are produced, the female fertilizes them using either stored or newly-acquired sperm.

Usually the female chooses appropriate plants (called 'host plants' or 'food plants' of the caterpillars) and parts of these plants for laying eggs. Then the caterpillar does not have to search for food, it simply starts eating what is around it. However, in certain species such as the Common Evening Brown and the Painted Lady, the female lays its eggs anywhere close to the larval host plants and the caterpillars have to find the right plants on which to feed. In either case, the butterflies show the remarkable skill of a botanist, almost never misidentifying the plants. The eggs are laid on fresh vegetative or reproductive shoots of the host plant, depending on the food the caterpillar eats. They may be laid on the upperside or the underside of the leaves.

The caterpillar eats through the top of the egg, creating a hole through which it emerges. After hatching, it often eats the eggshell as its first meal: this gives it invaluable nutrients, as well as helps remove evidence of the egg which may otherwise draw the attention of parasitoids. Since hatching, the caterpillar continuously weaves, on the leaf, a mat of silk threads on which it walks. This silk is fundamentally the same as that which is commercially used. The silk is produced by a spinneret situated behind the mouth-parts, so the caterpillar has to move its head from side to side in order to weave the silk mat. The newly-produced silk sticks to the surface of the leaf, thus forming a kind of rope-work on it. This silk helps the caterpillar to hold on to the leaf. There is some evidence that the silk threads may also serve as a chemical trail. They can help the caterpillar trace back its path if it has a particular hideout, or help other caterpillars know its route. After the first meal of the egg shell, different species of caterpillars feed on specific plant parts such as fresh or mature leaves, the insides of fleshy fruits, flowers and tender pods. However, a few species, for example, the Mottled Emigrant and the Common Banded Awl, may eat all the edible green tissue of the host plant.

Two things are very striking when one observes the caterpillar. It is either eating, or sitting motionless. Since this is the only growing stage in a butterfly's life, it has to consume as much food and store as much energy as possible. As a result, it does get obese. And it achieves this very quickly. Its jaws work like scissors—very rapidly and efficiently and it finishes leaf after leaf on branch after branch, until its seemingly insatiable hunger is assuaged. However, when not feeding, it had better keep still, otherwise it might ruin its prospects of surviving by drawing predators' attention to itself. The caterpillar is usually well concealed, so it would also help if it is motionless.

A butterfly caterpillar casts off its outer skin layers five times in its life. The caterpillar stage between two moults is called an "instar". The caterpillar grows rapidly, so periodically it has to moult. Then it can continue eating and growing without over-stretching its smaller rigid head and old skin. Roughly a day before moulting, the caterpillar stops feeding and remains motionless. A few hours before the actual moulting, a bulge appears at the second segment, that is, behind the head of the caterpillar. This bulge is the new, enlarged

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head of the caterpillar. The skin of the caterpillar ready for moulting ruptures just behind the head and the caterpillar walks out to leave behind a wrinkled moult. It often turns around and eats its moult. After moulting, the caterpillar grows faster than ever for a short while. In many species the caterpillar also changes colouration while casting a moult. Therefore, its appearance may change so dramatically as to raise doubts about whether it is the same individual at all!

This growth is halted only when the caterpillar is about to pupate. Before pupation it may wander far from the plant on which it had been feeding, occasionally making long journeys of up to 10–20 m away from the plant. Once it finds a safe place to pupate, usually near the ground or in dense foliage, it weaves a dense pad of silk to which the pupa is later fixed. Attached to the silk pad is also a body-band encircling the caterpillar. This is seen in Swallowtails, Whites and Yellows, Skippers and certain Blues. On the silk pad the caterpillar rests or hangs for a day or two, slightly curled and contracted. At the right time the skin ruptures, usually on the third segment. Then the caterpillar wriggles and draws back the skin towards its rear end, finally freeing itself from it. However, this time the post-moulting appearance of the caterpillar is completely different. There is no longer any head capsule, no jaws and no legs. The new appearance is of a relaxed and wet pupa. The pupa then contracts, reducing in length and increasing in width, so that it is short and compact, and therefore less conspicuous. A few hours after moulting, the pupal skin hardens, tubercles or other projections and markings become distinct and the pupa gets its final form and colouration.

The pupa is the third and dormant stage in the life cycle, during which tissues of the caterpillar are rearranged for its life as an adult butterfly. The outward appearance of the insect also changes. The prolegs and biting mouth-parts vanish and the wings, proboscis and compound eyes appear. The structure of true legs changes and the head, thorax and abdomen become distinct sections. The body is covered in scales.

The adult butterfly emerges from the pupa after a few days. This usually takes place at or before dawn, so that by the time of its activity period, the newly-emerged individual has spread and dried its wings. This is probably the time when predation also is less likely on the completely helpless and therefore vulnerable butterfly with yet unacquired power of flight. Roughly a day before it emerges, the colouration of the butterfly to emerge starts showing through the now-transparent pupal skin. The wings acquire their patterns, hairy scales on the thorax and abdomen become apparent and occasionally the texture of the eyes and legs also can be seen. Then, the ready-to-emerge butterfly pushes the pupal skin from inside with its legs so that it can emerge. The pupal skin breaks along the antennal case on either side, and the pupa opens in front like a door. The butterfly slips out and holds on to the surface on which it pupated, or to a nearby place where it can suspend itself. This suspended position is important, because it has to extend its miniature wings. The newly-emerged butterfly is unrecognizably different as its wings are crumpled, looking like mere stubs and the butterfly is wet. When the butterfly suspends itself, blood is pumped into veins of its wings and then the wings start slowly unfolding. It takes over 10 minutes, depending on the ambient temperature, to completely extend and dry the wings. Meanwhile, the butterfly manoeuvres and joins together two parts of its proboscis to form a tube that it later uses to suck its liquid food.

The adults are assigned the function of reproduction, which involves finding mates, searching for larval host plants and laying eggs, all of which take a long time. However, this stage is usually short-lived compared to the early stages in an average butterfly's life. And many individuals never reach this stage. The irony is that this stage attracts the

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maximum attention of human beings—whether lay persons or those well-versed with butterflies. We know best about this stage, another illustration of our fascination for ephemeral things. Therefore, our knowledge of the various aspects of adult butterfly biology is relatively more advanced, which will be discussed in sections that follow.

Different stages of development take different amounts of time. Usually the caterpillar stage is the longest and the egg stage is the shortest. The egg takes usually not more than two to four days of the life span, depending on the size of the butterfly (however, the egg of the Tamil Lacewing may take over a week to hatch). The caterpillar takes roughly between 15 and 40 days, depending again upon the size of the butterfly and also the time of the year. Caterpillars growing during the monsoon take a shorter time than those in the summer. The pupal stage lasts for about 6 to 15 days, but this depends on the season. As in the caterpillar, the pupal stage also takes a shorter time if the temperature is suitable. Low temperatures decrease the rate of physiological processes, and hence growth is slower. The adults survive for anything between a few days and a couple of months, the larger species usually survive longer. Species that spend a season or two in a dormant state depart from this general pattern. Depending on which stage remains dormant to tide over unfavourable periods, either the egg, caterpillar or pupa may take much longer than usual to change to the next stage, up to several months.

1e. Stages in a Butterfly's Life

- **The Egg** The egg has a slightly hardened covering to protect the life that develops inside it. A thin layer of sticky material covers the egg as it is being laid, this material fixes the egg to the surface on which it is laid. There is prominent ornamentation on the surface of the eggs of most species. This ornamentation consists of tiny ridges and pits and polygonal cells, intersections of which may be raised. However, the eggs of Swallowtails and some Brush-footed butterflies, for example, the Tailed Jay and the Common Palmfly, are not ornamented. On top of the egg is a microscopic pore, the '*micropyle*', situated in a tiny *micropylar pit*. This is the area through which the egg is fertilized and from where the caterpillars usually hatch.
- **The Caterpillar** The caterpillar is a swollen bag stuffed with organs. It lacks any hard structures, except the head. The head is a hard, chitinous capsule in contrast to the larval skin, which is soft and flexible. The skin is the only binding and supporting structure of the caterpillar, as there is no skeleton.

  The body is segmented and the segments usually look distinct. There are in all 14 segments. The 1st is the head, the 2nd, 3rd and 4th are thoracic segments, and the 5th to 14th are abdominal segments.

1. *The Head* The head has a central groove, separating its two lobes. The lobes may be produced on top into small points or long horns. At the base are the 'biting and chewing' type of mouthparts, with jaws that work sideways. Behind the jaws is a *spinneret*—the silk-spinning organ. On the sides are the bulging 'cheeks', close to which are situated the simple eyes (compound eyes are present only in an adult butterfly), which look like small bumps. The surface of the head may be smooth, granular and plane or tubercled.
2. *The Thoracic Segments* The 2nd segment may be very narrow, forming a 'neck' that can twist and turn to a great extent. It is very distinct in Skippers. A pair of small true legs is present on each thoracic segment. These legs are used to grip the leaves on which the caterpillar feeds.
3. *The Abdominal Segments* Segments 7 to 10 each have a pair of fleshy prolegs, which are present only in the caterpillar.

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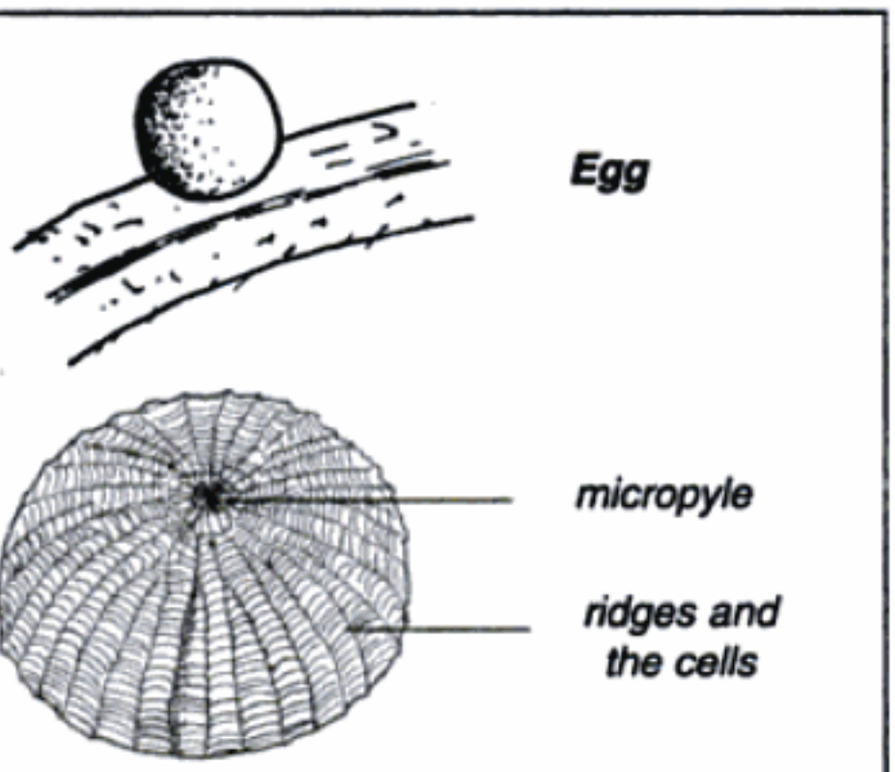
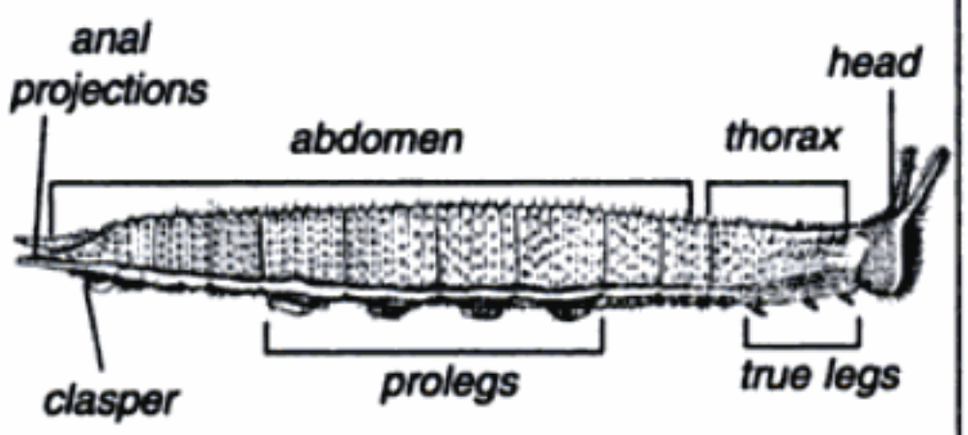
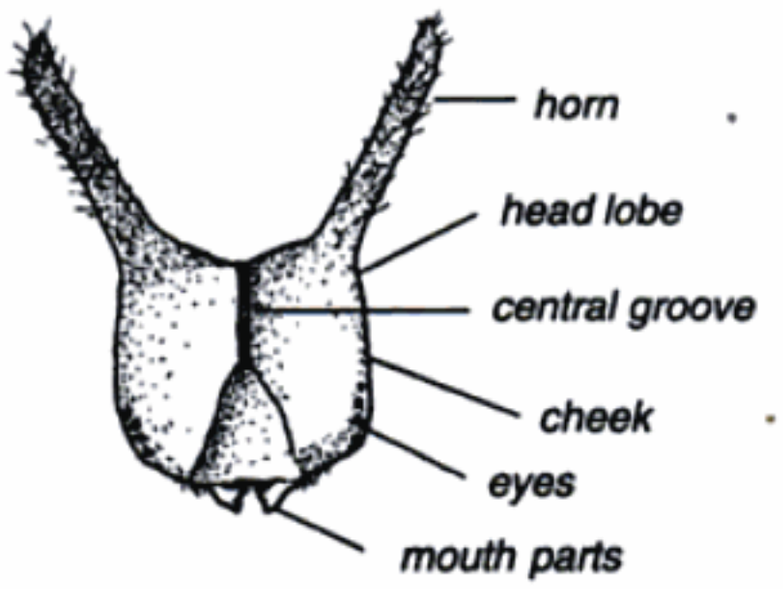


Egg

Microscopic view of the egg



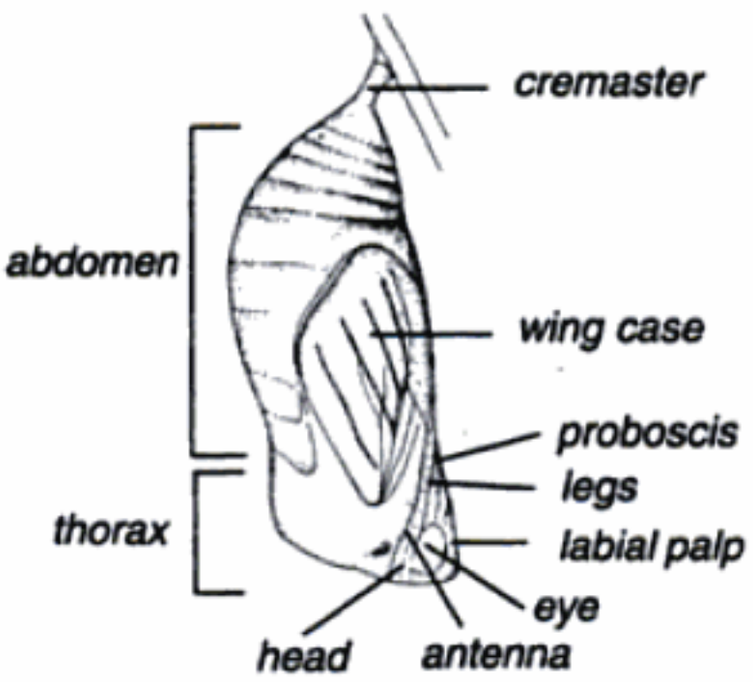
Caterpillar



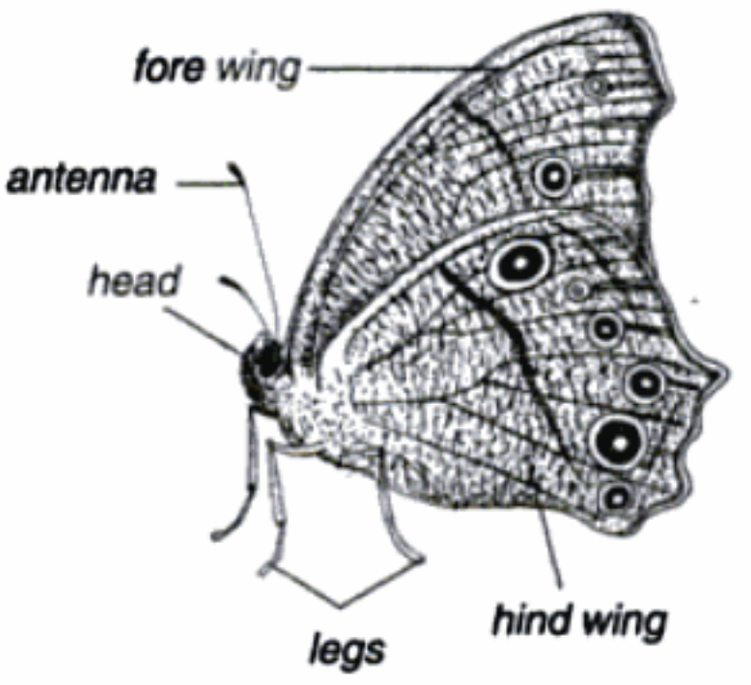
Head of a Caterpillar

They help in holding the silk threads on the surface on which the caterpillar rests. At the 14th segment is an additional, larger, fleshy pair of prolegs, called "claspers". These have the strongest hold on the surface and are also employed when the caterpillar suspends for pupation. A fleshy flap covers the anus from the top, usually making the anus invisible.

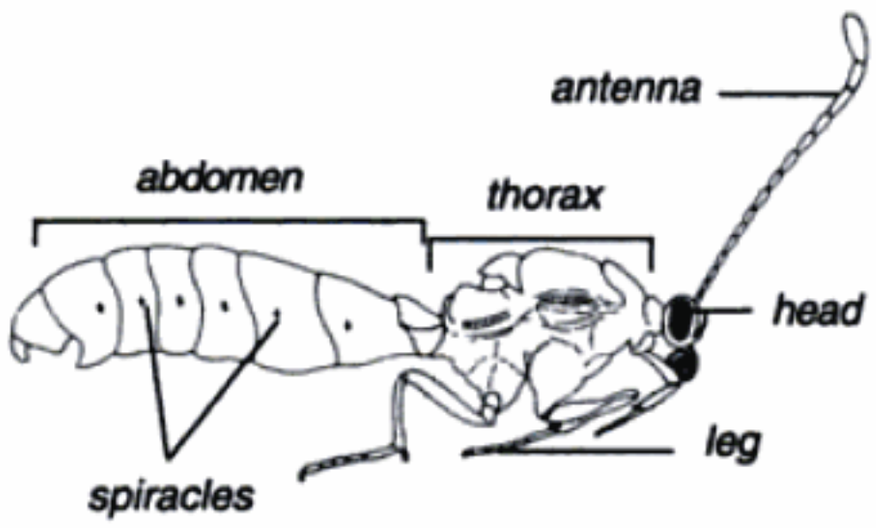
The surface of the body may be tubercled and each tubercle may bear a spine or hairy outgrowth. At the lower side of the body are spiracles, situated on the 2nd and 5th to 14th segments.



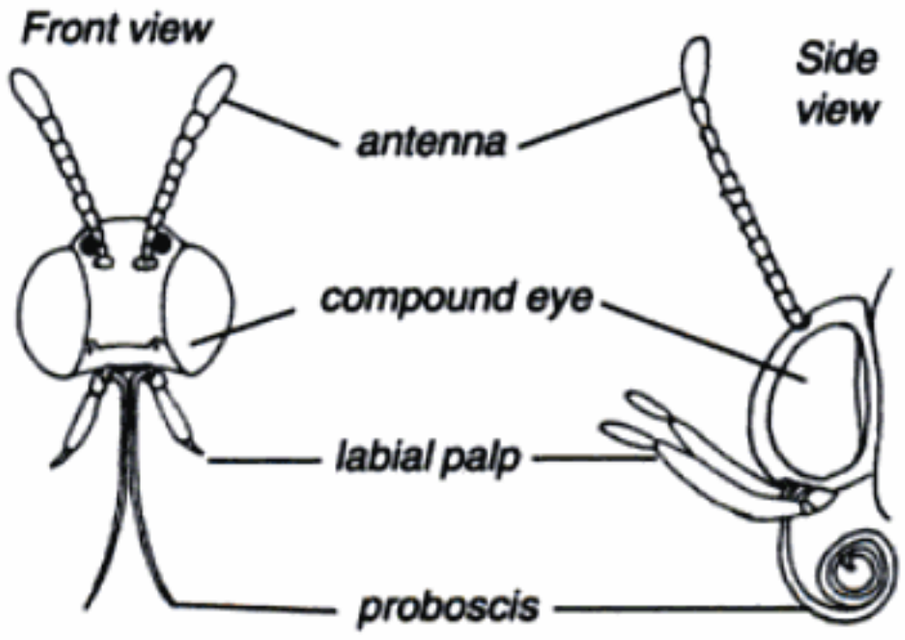
Pupa



Adult



Adult Butterfly Without the Wings



Head

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Spiracles are small pores that open inside through a network of microscopic tubes, which finally communicate with the various parts of the body. The caterpillar and adult breathe through the spiracles.

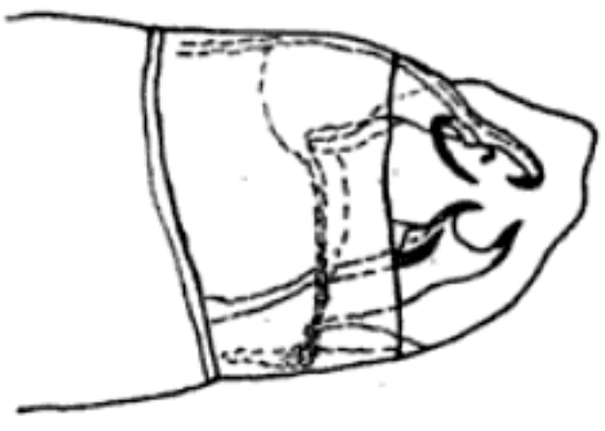
- **The Pupa** The pupa is simply a representation of an adult butterfly, with all the organs outlined. However, its wings are small and applied close to the thorax on the lower side and the proboscis is straightened to lie between the wing cases. Compound eyes, *labial palpi* (singular, *labial palp*), legs and all body-parts are clearly differentiated and defined.
- **The Adult** In an adult butterfly only 13 segments are apparent. The thoracic segments are covered by a tough chitinous layer, so they cannot bend. The abdominal segments, however, are flexible and slightly extensible. On the head are two very large compound eyes, a pair of minute simple eyes, a proboscis, the labial palpi and a pair of antennae.

The compound eyes occupy most of the facial surface. They are composed of several thousand lenses and are useful in detecting short-range movements. In spite of the large number of lenses in its eyes, the butterfly has poor sight compared to human vision. However, it perceives ultra-violet light. The simple eyes are minute, situated between the two compound eyes and help distinguish between light and darkness. The proboscis is kept coiled in front of it's face. Its composed of two parts, which, when joined, form a tube through which liquid food can be sucked 'in' is superfluous. Things can be only sucked in; not sucked. The proboscis is usually hidden, completely or partly, between the hairy labial palpi. On top of the head, between the compound eyes, are two segmented antennae, which are associated with the sense of smell.

The wings, arranged in two pairs on the thorax, are rigid but delicate. They are supported by a network of veins through which the blood circulates, and are covered with detachable scales. The scales come in a variety of structures, each type serving a different purpose. Some are scent scales that are helpful in chemical communication among the sexes. Other structures provide particular colouration to the wings due to their ability to peculiarly reflect or refract light.

Each thoracic segment possesses a pair of legs. In the subfamilies of Nymphalidae the first pair may be highly reduced. The leg is segmented, as in all other arthropods. At the tip is a sharp claw that firmly holds the surface when the butterfly rests or suspends itself upside down.

The reproductive organs, collectively called 'genitalia', are at the end of the abdomen, arranged within the last few segments. The genitalia of male butterflies possess hooked structures that grasp the abdominal tip of female butterflies. This keeps the pair in the correct position during mating. The structure of genitalia is very important in identification of certain groups of butterflies where species identification is otherwise difficult, such as certain Albatrosses, Lineblues, Swifts and Pierrots. In fact, final identification among some species from these groups is largely dependent on genitalia structure. Differences in genitalia structure are believed to play a crucial role in species formation among butterflies. For example, it is supposed that subtle differences in genitalia structure may prevent mating between individuals of the same species, thus giving rise to two sexually isolated groups in a species. These structural differences in genitalia then maintain differences in other



Section of abdomen of a male butterfly showing genitalia

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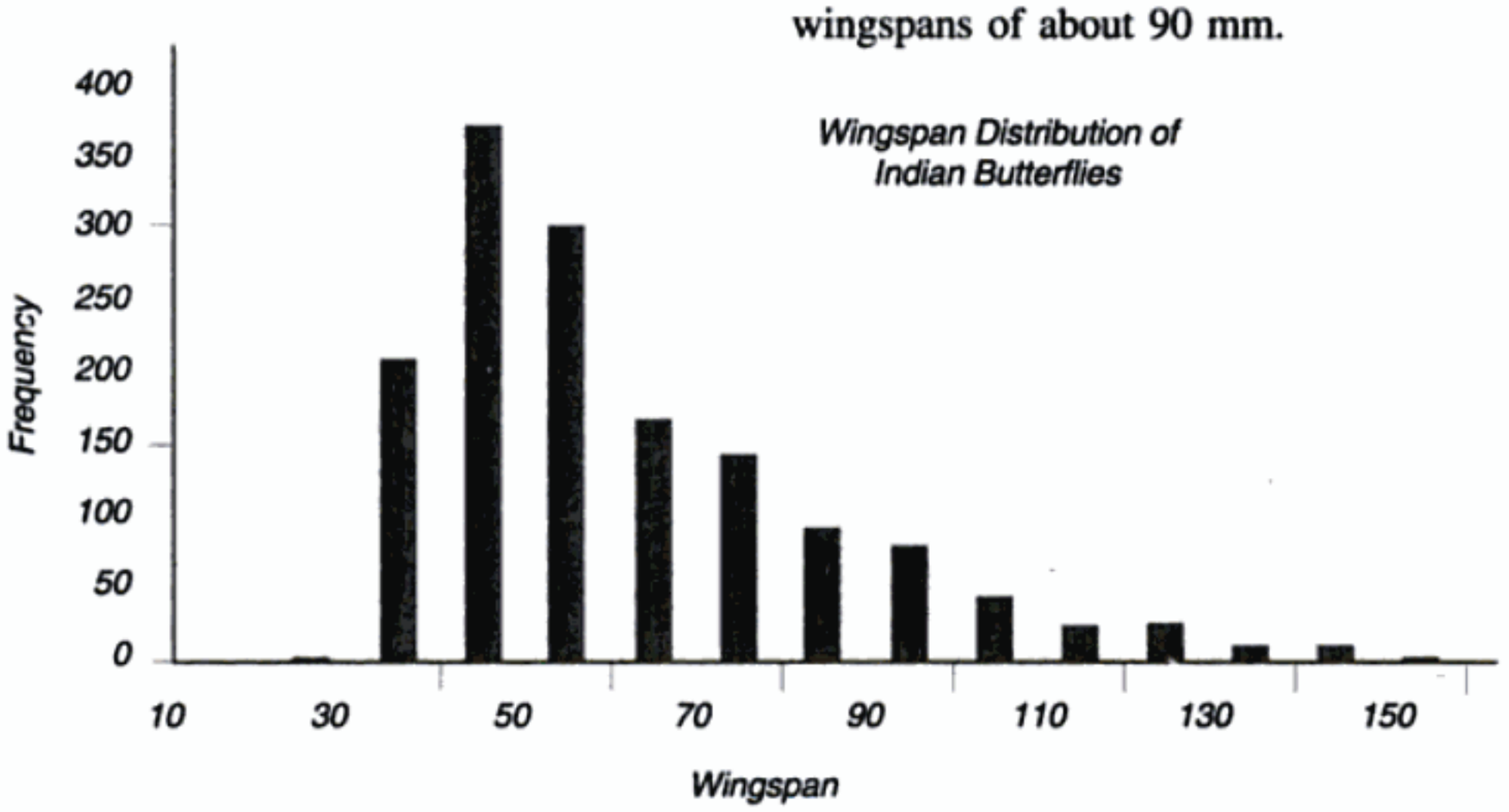
characters among closely related groups. These eventually become different species although outwardly they may look similar.

1f. The Big and The Small Butterflies

Butterflies come in various sizes. The smaller Blues are no bigger than a fingernail and the largest Swallowtails are larger than the smallest birds. The tiniest butterflies in the world: the Grass Jewel and the Tiny Grass Blue (wingspans: 15–22 mm and 16–24 mm, respectively), are smaller by a factor of ten than the world's largest butterfly: the Queen Alexandra's Birdwing, *Ornithoptera alexandrae*, measuring about 250 mm between its wingtips. Both the world's smallest butterflies occur in peninsular India, but it is the Southern Birdwing that commands the title of the largest here (wingspan: 140–190 mm).

Among the Indian butterflies, Swallowtails are overall the largest. Their wingspans vary widely between 40 and 160 mm, but close to 70% of the species range between 80 and 130 mm. Brush-footed butterflies are very diverse in their body form, habits and habitats. They exhibit their family's heterogeneity in their wingspan ranges as well. The smallest of the Bushbrowns and Rings are merely 30 mm between their wingtips compared to the largest Jungle Queens (*Stichopthalma* spp.), which measure as much as 150 mm. While about 60% of them are between a narrow range of 50 and 80 mm, the rest are usually larger. At the other end of the spectrum are the tiny Blues, which range between 15 and 60 mm (an exceptionally large member: the Moth Butterfly, *Liphyra brassolis* Westwood, has a wingspan of 90 mm), but close to 80% of species are between 30 and 50 mm. Skippers are also small. About 80% of the species have their wingspans between 20 and 50 mm. The rest: the Awlets, Awlkings and Redeyes, are larger and some Redeyes have wingspans of about 90 mm.



Wingspan Distribution of Indian Butterflies

This figure shows wingspan distribution of all Indian butterflies. Number of species are given for each wingspan class of 10 mm.

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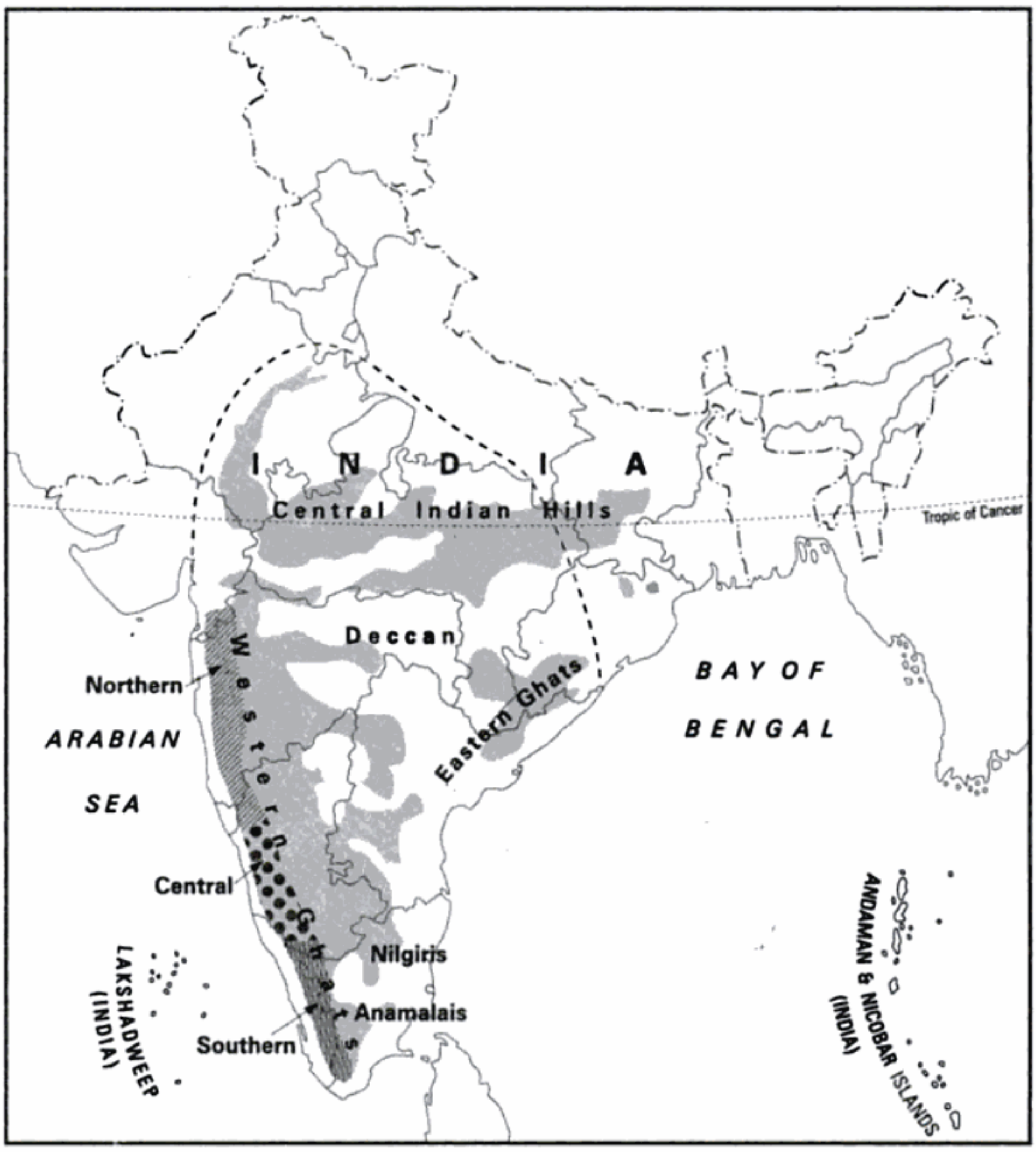
2. Ecology of Butterflies

2a. Habitats of Butterflies The habitat of an organism is the place where it lives. Thus, marshes, rivers and lakes are the habitats of a crocodile, forest of a tiger, urban and rural areas of a kite and gardens and rocky areas are the habitats of the Red Pierrot. Unlike birds, mammals and beetles, none of the butterflies are particularly associated with aquatic habitats such as lakes, rivers or oceans. Some species, for example, the Peacock Pansy and the Grey Pansy, will be found abundantly along water bodies because their larval host plants grow profusely close to the water. However, they do not have a direct relation with the water, as the aquatic animals have. Thus, habitats of butterflies are

Map Of India

Showing the regions mentioned in the text
(limits of the Indian peninsula as defined in this book)



(see Plate 32a for colour map)

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strictly terrestrial. It is only within this restricted scope that butterflies have evolved and occupied all possible habitats, even those with scanty vegetation.

Virtually all butterflies are associated with plants and therefore their occurrence depends on the presence of plants. Plants, in turn, depend upon water and soil regimes, light and minerals and also respond to certain disturbances such as grazing and fires. Depending on all these factors, plants of similar physical appearance and the preference for some abiotic factors and specific nutrients often form distinct vegetation types. The following vegetation types in peninsular India are important in terms of their geographical extent and importance to butterflies.

1) *Tall Evergreen Forests* (Plate 4, no. 19) Tall evergreen forests grow where annual precipitation is high (2,000 to 6,000 mm) and is spread over 4 to 10 months. Almost all the trees are evergreen, so the forest is lush throughout the year. The vegetation covers over 95% of the ground. The trees are 25 to 40 m tall, the trunks are huge, some of which may have large buttresses. The characteristic trees of these forests belong to the families Dipterocarpaceae, Clusiaceae, Euphorbiaceae, Lauraceae and Flacourtiaceae. Many of these trees are used by butterflies either as nectar plants or larval host plants. A few lianas reach the canopy using the support of the large trees. Shrubs and saplings of trees comprise the undergrowth, with very few herbs. However, in the openings created by paths and tree-fall gaps, grow abundant herbs, which are mostly of the family Acanthaceae. In peninsular India these forests are found only in the Western Ghats, more or less south of Goa, although a few patches occur in Maharashtra. These occur from sea level to about 1, 500 m above sea level, but are more or less restricted to the valleys and slopes.

Tall evergreen forests are one of the most important habitats of butterflies. Most of the butterflies endemic to peninsular India occur in this forest type. Streamsides and small openings in the tall evergreen forests are the best places to watch butterflies, as majority of them frequent these patches. Since these forests have plants of varied heights, they offer diverse micro-habitats. There are butterflies flying in the canopy and the undergrowth and in the openings as in the shade. Some species specialize on herbaceous plants, others on canopy trees, yet others use herbs as much as the trees. Thus, the multi-storeyed, tall evergreen forests are believed to form a complex of diverse micro-habitats that result in a high butterfly diversity. The Malabar Tree Nymph, Clipper, Red-spot Duke, Paris Peacock, Common Bluebottle, Tree Flitter, Snow Flats and Common Albatross are some of the characteristic butterflies of this habitat.

2) *Stunted Evergreen Forests* These evergreen forests usually replace the tall evergreen forests in the northern Western Ghats (Maharashtra) and, in the southern Western Ghats, on the high ridges at altitudes above 1,200 m or so. The trees are only about 10–15 m tall. The branches start close to the base of the trees, they are gnarled and often covered with moss. Over 80% of the trees are evergreen. The undergrowth is composed of shrubs such as *Strobilanthes* and other Acanthaceae members, but herbs are rare. The forests are often impenetrable due to the thick undergrowth.

This is not a very attractive habitat for butterflies. The undergrowth is thick and not rich in nectar sources. However, the edges of the forest are a good habitat for certain butterflies, for example, the Swallowtails, Bushbrowns, Rings, Hedge Blues, Flats and Swifts.

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3) *Shola Forests* (Plate 4, no. 20) By definition, stunted evergreen forests in the valleys above 1, 800 m are called 'shola forests' or 'sholas'. However, the vernacular language in Tamil Nadu refers to any evergreen forest as a shola. True sholas are strictly valley forests, with the surrounding ridges and higher slopes occupied by montane grasslands. These forests appear similar to the stunted evergreen forests of the lower elevations. The latter often continue higher as sholas. Sholas are found mainly in the Nilgiris southwards in the Western Ghats, where this habitat itself is endemic.

Sholas are a unique habitat for butterflies. All the originally northern Eurasian butterflies that occur in peninsular India are endemic to the sholas and surrounding montane grasslands. These include the Nilgiri Clouded Yellow, Indian Red Admiral, Indian Cabbage White and Indian Fritillary. They are found either inside the sholas or at their edges. The Nilgiri Tiger, one of the Western Ghats endemics, is also more common around the sholas. Thus, although sholas do not support a large number of butterflies, they harbour some of the most noteworthy species. Moreover, they have exclusive endemics in the form of the Red-eye Bushbrown (restricted to the Nilgiris) and the Red-disc Bushbrown (restricted to the Anamalais and mountain ranges south of it).

4) *Semi-evergreen Forests* Semi-evergreen forests are a mixture of evergreen and deciduous trees and often form a transition between the two forest types. They are fairly tall, with the trees between 15–25 m high, and a dense canopy. About 40 to 80% of the trees are evergreen, depending upon the rainfall. Climbers and lianas are plentiful, the undergrowth is dense but penetrable, herbs and shrubs are abundant, but grasses occur sparsely and mostly in disturbed, open areas. These forests occupy areas from sea level to about 1, 500 m above sea level, wherever the annual precipitation is between 1, 200 to 5, 000 mm and spread over 4 to 8 months. Extensive patches are found mainly in the Western Ghats and the Eastern Ghats.

Semi-evergreen forests are perhaps the best butterfly habitats. Due to their heterogeneous plant composition and diversity, they can support myriad butterflies. Since these are between the deciduous and the evergreen forests, they draw butterflies from both the habitats, thus supporting many more species than either habitats do.

5) *Riparian Forests* (Plate 4, no. 21) Riparian forests, that is, 'river-side' forests have a special significance for butterflies, especially in the deciduous and the semi-evergreen forests. These are moister than the surrounding patches and remain lush even in the summers. The butterflies concentrate in the riparian patches during the dry months. In fact, during the summers these forests are teeming with dozens of species of butterflies. The butterflies assemble here because all the mud-puddling sites and nectar sources are available only here in the summers. Thus, riparian patches constitute a crucial habitat for butterflies.

6) *Deciduous forests* Deciduous forests can be dry or moist. This depends on the amount of rainfall and the number of dry months in the forest. If a forest receives 1, 200 to 1, 500 mm precipitation, spread over 4 to 7 months, it is referred to as a "moist" deciduous forest and if the rainfall is lower, then it is called a "dry" deciduous forest.

6a) *Moist Deciduous Forests* (Plate 4, no. 22) Moist deciduous forests have moderately tall trees, about 15–20 m tall, whose canopy is not very dense. Most trees are deciduous, so the forest is bare in the summer. Some of the prominent tree genera in these forests are *Lagerstroemia*,

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Terminalia, *Dillenia*, *Schleichera*, *Xylia*, *Adina* and *Mitragyna*. In the northeastern peninsula these are dominated by sal trees (*Shorea robusta*). The undergrowth comprises diverse shrubs, herbs and grasses. In disturbed and rocky places, extensive weeds such as *Lantana* and *Chromolaena* may be found. Lianas are few. Moist deciduous forests occur in the Western Ghats and the central and eastern Indian hills (Vindhyas, Satpudas, Bastar) that receive higher rainfall.

These forests form an excellent habitat for butterflies. Denser patches and riparian patches in these forests are suitable places for butterflies since they harbour most of the plants that butterflies use as larval and adult food sources. Some of the commoner butterflies of this forest type include the Commander, Pansys, Barons, Rajahs and Nawabs, Evening Browns and Tree browns, Tigers, Oakblues, Lineblues, Spot Swordtail, Common Emigrant and Grass Yellows.

6b) *Dry Deciduous Forests* (Plate 4, no. 23) These forests occur in areas with annual precipitation between 800 and 1, 200 mm, distributed over 3 to 5 months. The trees are short, about 10–15 m tall and the canopy covers about 40 to 60% of the ground. Evergreen trees are absent, except in the riparian zone. The dominant trees are *Anogeissus*, *Givotia*, *Sterculia*, *Lannea* and *Boswellia*. Herbaceous and grassy undergrowth is plentiful. This vegetation type occurs throughout peninsular India from sea level to 1, 500 m.

This is a habitat with a modest number of butterfly species. The butterflies occur seasonally with most species becoming active between the pre-monsoon showers and late winter. However, some freaks such as the Spot Swordtail may be active during the summer in the riparian patches when others are dormant. Other common butterflies from this habitat include Rings, Grass Blues, Orange Tips, Grass Yellows, Swifts and other grass-feeding Skippers.

7) *Bamboo Forests* On rocky, steep slopes where disturbance due to forest fires is regular, extensive stretches of bamboo clumps dominate. In moist areas, a few trees, such as *Schleichera* and *Xylia*, may be scattered in between the bamboo clumps. The undergrowth may be sparse but thorny. These are usually associated with deciduous forests and also occur on ridges bordering the evergreen forests.

Bamboo forests are good for Browns, especially the Bushbrowns and Rings, and also Pansys and Grass Yellows. However, on the whole they are poor in terms of richness of butterfly species.

8) *Scrub and Savannahs* (Plate 4, no. 24) These are the non-forest habitats with shrubby growth or very scattered trees and grassy–herbaceous undergrowth. Trees here are between 5 and 15 m tall. The number of evergreen plants varies from place to place, but deciduous trees are usually more common. The dominant plant families are Mimosaceae, Capparaceae and Euphorbiaceae. Scrub and savannahs occur throughout peninsular India and from sea level to about 1, 000 m where rainfall is between 400 and 800 mm. In areas of higher rainfall, these may be found on the ridges which have a thin layer of soil.

Scrub and savannahs in peninsular India are secondary habitats. They are derived from deciduous forests that are historically disturbed by intense grazing and recurring fires. The original dominant deciduous trees here gave way to the thorny plants that now dominate these habitats. However, the long history of disturbance has almost 'naturalized' these habitats, that is, they are now a part of the landscape with their characteristic plant species and appearance. The now-dominant thorny plants had adapted to

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survive in dry, disturbed patches, and found extensive land to colonize when human activities impacted the deciduous forests. Along with these plants, butterflies feeding on them have also found extensive land to occupy. The Salmon Arabs, Pioneer, Crimson Tip, certain Silverlines and the smaller Orange Tips are some of the butterflies that seem to have actually benefitted by the human activity of converting the deciduous forests to scrub and savannahs.

9) *Grasslands* Vast areas dominated by short grass are found throughout peninsular India on the Deccan plateau and on the steep exposed slopes and ridges in all the mountain ranges. These occur in areas which vary widely in annual precipitation, but always where the microclimate lacks sufficient moisture. Thus, when grasslands occupy areas under heavy rainfall, they cover only those areas where the soil layer is thin. The soil gets dry as soon as the monsoon is over, so large plants cannot survive there. Abundant herbs may grow among the grasses and short shrubs may also form dense clumps.

Like the scrub, grasslands in peninsular India are mostly secondary habitats maintained by livestock grazing and annual fires. Therefore, they may share many butterfly species with the scrub and savannahs. However, they have some species such as the Grass Blues and Grass Jewel, Painted Lady, Blue Pansy and Mottled Emigrant in much higher abundance.

10) *Montane Grasslands* Montane grasslands are the gentle rolling grasslands on the higher reaches of the Nilgiris, the Anamalais and other montane regions of the Western Ghats. Like the sholas, they are endemic to areas 1,800 m above sea level and are usually associated with them. They occupy ridges and slopes of valleys, confining the sholas to small patches at the bottom of the valleys. They are formed by short grass interspersed with abundant herbs and a few pteridophytes. Trees are absent and even shrubs are very rare and stunted.

As is true for the sholas, the montane grasslands are a host to originally northern Eurasian butterflies that are now present in peninsular India. The Indian Fritillary, Indian Cabbage White, Indian Red Admiral and Nilgiri Clouded Yellow occur commonly at the shola–grassland boundaries. Two species of Rings that inhabit the montane grasslands: the Nilgiri Four-ring from the Nilgiris and the Palni Four-ring from the Anamalais southwards, are found nowhere else in the world.

Any disturbance to habitats can change their usage and usefulness to the butterflies. A slight disturbance to the tall evergreen forests, which increases openings inside the forests, apparently increases diversity of the butterflies. The openings and the sunlight penetrating through allow plants from the moist deciduous forests to regenerate in the evergreen forests, thereby inviting butterflies from the deciduous forests as well. Small paths and tree-fall gaps in the evergreen forests also promote myriad herbs that attract butterflies, for they are either larval or adult feeding sources. However, heavy perturbation can disturb the vegetation so much so that weedy plants dominate and then the specialist butterflies from the evergreen forests lose their habitat. Even a slight disturbance due to forest fires however, depletes the original diverse assemblage of herbs and replaces it with a poor host—the unpalatable species of grasses.

Monoculture tree plantations, orchards and agricultural fields are now widely replacing the natural habitats of butterflies in peninsular India. However, they rate poorly in comparison with the natural habitats. Plantations of betel nut, eucalyptus and coconut are particularly poor in butterfly diversity. Teak plantations fare the best

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among the tree or forest plantations in terms of butterfly diversity. A few studies even indicate that teak plantations are better butterfly habitats than natural forests. However, this is true strictly for teak plantations that are regenerating and are therefore rich in other plant species. Teak plantations that are maintained free of regenerating wild trees and shrubs support very few butterflies. Moreover, most butterflies that occur in teak plantations are characteristic of disturbed vegetation. The species that primarily inhabit the natural forests with more or less unaltered vegetation avoid teak plantations. These butterflies are usually restricted in their geographical distribution as compared to the ones that occur in teak plantations. In any case, even the most diverse teak plantations, on their own, can support very few butterflies. They depend mainly on the neighbouring deciduous and evergreen forests for their butterfly species. Thus, the natural habitats serve as suppliers of butterflies to the man-made habitats.

Suggestions for student projects Detailed accounts of habitat use by Indian butterflies are not available. Earlier naturalists did not identify habitats as vegetation types, as we do today. Therefore, fresh information on the following will be very useful in all the regions of India:

- Which butterflies use which habitats?
- At which heights in multi-storeyed evergreen forests do butterflies occur more commonly?
- Which microhabitats are preferred by which species?
- Which habitats are more butterfly species rich than others and how does this ranking of habitats change when the habitats are subjected to various disturbances?

2b. Feeding Feeding is a significant activity and food may often be the most decisive factor affecting distribution, abundance and movements of animals. In butterflies, this has a special relevance because food and the mode of feeding are different in the larval and adult stages, so that the stages appear to be functionally different beings.

i) The Caterpillars Different species of caterpillars feed on a diversity of plant species. However, in a majority of species their food is fundamentally the same, namely leaves. Some caterpillars may prefer slightly mature leaves, some may refuse to eat anything other than tender ones; most prefer to eat tender leaves but otherwise eat whichever are available on the plants where they are placed by their mothers as eggs. The widest range of diets is exhibited by the Blues. Some caterpillars of the Blues feed on leaves, a few bore inside buds, some eat flower petals, others consume fleshy fruits and pods. A few extraordinary species feed on other insects such as ant larvae, green-flies (aphids) and mealy bugs. A few may also occasionally turn cannibalistic.

Although most caterpillars feed on leaves, there are strict preferences for specific host plants. These strict preferences are dictated by the chemical composition of the plant parts that the caterpillars eat. Therefore, the caterpillars feeding on a particular plant species or set of species will not eat leaves of other species. There are three levels of this specialization. The first level is where the caterpillars feed on a single plant species (technically termed '*monophagy*', meaning feeding on a single (host plant)). However, the preference is rarely so strict that it confines caterpillars to a single plant species. More commonly, caterpillars find plants of the same genus or closely related genera agreeable (termed '*oligophagy*', meaning feeding on few (host plants)). For example, in families of custard-apple (Annonaceae) and grasses (Poaceae), chemical variation across genera is not very great, so that plants from many genera of these families are accepted by caterpillars. Thus, they are specific to plant families, rather than to species or genera. At the third level, the choice of the host plants of caterpillars seems to be very flexible and they may feed on a number of plants belonging to altogether

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different plant families (termed '*polyphagy*', meaning, feeding on many (host plants)). Such butterfly species are typically characterized by their mutual dependence on ants (Blues), very widespread geographic distribution (the Commander and Common Sailer) and habit of migration (the Painted Lady). In the case of Blues, since the caterpillars are dependent on ants rather than on the chemical composition of plants (see section 2k: Adaptations to Escape Threats: Association with Ants), a compromise can be made on the species of host plants. In the second and third cases, the caterpillars may feed on different host plants because the plants may have a relatively limited distribution range, or different plants in different regions may be locally more suitable in terms of availability and nutritional value.

Unlike human beings, most animals cannot manipulate their environment and afford the luxury of growing and selecting their food. So their feeding and growth is severely limited by what their environment provides them. The caterpillars are among the least independent due to their poor mobility. Their destiny is determined not by their choice, but by their mothers' choice of the host plant and by changes in the state of the plant that might take place after the eggs were deposited. The growth of the caterpillars is dependent on the moisture content in the leaves, the ambient humidity and temperature and their own level of crowding. These factors may change in a short time and therefore the suitability of the plants may also change. Usually, individual plants with higher water and nitrogen content in the leaves are better suited for larval growth.

However, why are only certain plants eaten by particular caterpillars? Host plant selection among butterflies has a long history. All plants contain specific chemical compounds and the physiology of caterpillars is designed to efficiently digest only certain compounds, in certain proportions. The evolutionary history of host plant specialization in a butterfly species starts with a few lines of individuals consistently feeding on certain plants. A higher degree of specialization by butterflies confers some advantages. For example, when only plants from a narrow range are used as host plants, slowly the senses of individuals get refined at finding those plants with greater accuracy and efficiency. The caterpillar also digests the food more efficiently, as it is tuned to specific compounds and their proportions in the plants. After generations of specialization on certain plants, a stage arrives where a caterpillar can no longer accept any other plant outside this set of plants.

Bizarre adaptations during evolutionary course are not such a rare phenomenon. Yet, it is something of a great surprise to find Brahma's caterpillar that devoured his ornamental plants, turning insectivorous. Certain Blues caterpillars like the Apefly, feed on mealy bugs and not on leaves. The evolution of leaf-eating caterpillars into insect-eating ones took the course probably as follows. As the leaves grow older, they increase their stock of harmful compounds, called secondary compounds. Caterpillars grow better if they avoid such leaves and feed more on fresh leaves, which contain less browsing deterrents and more nutrients. Due to this, the Blues probably specialized in feeding on tender leaves and boring into the buds. Young leaves of different plants are chemically less different from each other as compared to mature leaves. Due to this, and perhaps reinforced by their heavy dependence on the ants that attend to them (see section 2k. Adaptations to Escape Threats: Association with Ants), the Blues probably could, or were forced to, feed on a variety of plant species. On these plants they were constantly exposed to certain soft-bodied insects (for example, the aphids) that suck their food from tender plant tissue, and which are also attended to by ants. The Blues caterpillars fed on these insects initially by mistake, later by habit. Slowly they specialized in eating these insects, completely abandoning their vegetarian diet. Whatever may be the actual process, these Blues can no longer survive on vegetable matter.

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Suggestions for student projects Many studies can be carried out to investigate the feeding habits and ecology of butterfly caterpillars. For these studies, already published information on host plants of butterflies will be useful. However, locality-specific information also can be used, or in fact, will need to be gathered afresh from the field. Questions that can be addressed from this information are diverse. For example, it will be interesting to find out which species are generalist feeders ("polyphagous species"), which are specialist feeders ("monophagous species"), and which are in between ("oligophagous species"); and what are their shared and distinguishing characters. Are local and regional patterns in host specificity similar? Or are species locally very specific to feeding on only one or two plants, but in different areas feed on a different set of plants; thus, they are locally specialist feeders, but regionally generalist feeders? Do growth rates on different host plants differ? To what extent does the family and subfamily of the butterfly determine whether it is a specialist or generalist feeder? It will be useful to look at all the species from an area to study their host plant use and broad habitat-wide and butterfly community-wide patterns of host plant specializations.

ii) The Adults Butterflies are so often seen and imagined with flowers that the fact that large number of butterfly species feed on other resources may seem strange. Imagine a butterfly sipping from a glass of wine, sucking tree sap, sitting on the sweaty hands and shoes of a trekker or on a pile of rotten bananas, and even worse, relishing fluids from a rotting, stinking crab and animal droppings. Yet, all this happens. In fact, some species lack interest in nectar and flowers. Thus, the diets of adult butterflies are even more varied than their caterpillars, and include nectar, alcohol, rotting fruits or other vegetable matter, tree sap, certain rotting animals, minerals from wet soil and varying combinations of all these.

However, since the caterpillar stage is already assigned the task of accumulating energy for life as an adult, why do adult butterflies have to feed at all? This is because the diet of caterpillars is biased. They feed on leaves and therefore consume a large amount of carbohydrates, but very little proteins and salts, which are also essential either for a longer life span or for acquiring mates and producing a greater number of eggs (see section 2d: Mate Acquisition Strategies). Thus, the diet of caterpillars is not "balanced". So the adults have to supplement the store of nutrients that the caterpillars accumulate, completing the repertoire of necessary nutrients.

Although nectar-feeding butterflies may seem to be concerned merely with the presence of nectar in flowers, the selection of adult food sources is not as random as it appears. For example, the butterflies do not feed indiscriminately from any flowers that they might find. There are preferences for nectar with specific chemical composition. In laboratory experiments, the European Peacock Butterfly (*Inachis io*) preferred plain sucrose sugar solutions to fructose solutions which, in turn, were preferred to glucose solutions. In tests with mixed sugar solutions, butterflies preferred both sucrose-dominant and balanced sugar solutions to hexose-dominant sugar solutions. Moreover, there were sexual differences in nectar preferences. The Peacock Butterfly females, in the above experiments, consumed more of the balanced sugar solutions than the males.

Factors other than nectar composition may also affect flower selection by butterflies. These factors may include physical parameters, such as: a) the height at which specific flowers are situated in a forest, b) corolla tube-length of the flower, c) proboscis length of the butterfly, d) size of the butterfly, and e) nectar store of the flower or flowering plant. These factors may act together to bring about flower selection by butterflies, as follows.

Many butterflies stay close to the ground, or spend more time near it and rarely fly higher (for example, the Mormons and Red

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Helen). On the other hand, some species spend most of their time in the canopy, descending to the ground less frequently (for example, the Tailed Jay and Common Bluebottle). Therefore, depending on the vegetation layer the butterflies use, they will feed more on herbs and shrubs near the ground or large trees and woody climbers high up in the forest canopy. Once some flowers are eliminated from the butterflies' diets due to their vegetation layer preferences, floral parameters may come into play. For example, a large butterfly with a long proboscis can feed on flowers with long corolla tubes. However, many butterflies feed on smaller flowers despite having a long proboscis. Naturally, butterflies can take nectar from flowers that have corolla tubes equal to or shorter in length than their probosces. Among butterflies, the length of the proboscis usually increases with the body length. Therefore, as the size of the butterfly increases, it is increasingly at an advantage because it would encounter more and more flowers of varied corolla tube lengths from which it can take nectar. However, smaller flowers would have smaller quantities of nectar and *vice versa*. So the choice is between small versus large flowers, taking into consideration a butterfly's proboscis length and body size. Small flowers mean little nectar, so visits to a greater number of flowers and a more laborious search for them is required. On the other hand, large flowers means a fewer number of visits and more nectar per visit to a flower. Is it not then beneficial for a butterfly of any size to try and feed from as large a flower as the length of its proboscis allows; and to try and *avoid* feeding on smaller flowers, instead spending that time searching for large flowers? It is one of the questions for which we do not have an answer.

A few butterflies also feed on pollen along with nectar, and in fact pollen may form a more important part of their diet. Therefore, these butterflies search not merely for nectar-rich flowers, but for flowers loaded with pollen. Of course, pollen being a solid food, the butterflies cannot consume it directly, as they are only equipped to suck liquid food. Therefore, the pollen is ingested along with the nectar. When the butterflies take off from the flowers after feeding, some pollen grains stick to the labial palpi on their faces. When these butterflies go to other flowers of the same plant species, those flowers are pollinated with the pollen carried by the butterflies. Thus, butterflies that feed on either nectar, or nectar and pollen, help in pollination. This symbiotic relationship has taken final shape in a few plants that have evolved with butterflies feeding on their pollen and nectar. They are pollinated solely by butterflies. An example of such an exclusively butterfly-pollinated plant in peninsular India is *Cadaba fruticosa*, a climbing shrub in the dry areas, which is one of the larval host plants of the Pioneer butterfly. Pollen is rich in proteins and amino acids and therefore it has an important role to play in a butterfly's life, as discussed in section 2d: Mate Acquisition Strategies.

A single food source of butterflies, nectar from flowers, has attracted most attention among researchers, and for precisely this reason it may be interesting to study those butterflies that never exploit it. Nectar is more guaranteed and abundant than other sources. For example, rotting crabs a specific period after their death, are probably much rarer, and their availability more unpredictable. This contrast in resource availability may have a profound effect on rarity and commonness of butterfly species. Certain butterflies that feed as caterpillars on commonly available host plants are rare probably for two reasons. They either suffer from higher rates of parasitization, or as adults they feed on rare and sparsely-dispersed sources. A possible example is the Black Rajah (*Charaxes dolon* Fabricius), whose caterpillars feed on tamarind and adults on tree sap, carnivore droppings and rotting fruits rich in alcohol. Perhaps due to the very ephemeral nature of their food, the adults will

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have difficulties in dividing their time between finding those resources and the business of reproduction.

For many butterflies, drinking at wet soil patches is an important feeding activity. However, since it has more profound implications on reproduction than other feeding resources have, it is discussed in the section 2d: Mate Acquisition Strategies.

Suggestions for student projects There is only a little work that has been done on the feeding habits and food sources of adult butterflies as compared to those of caterpillars. Therefore, it will help if someone studied the physical parameters outlined above that may be affecting feeding by adults. For this, notes on the following will be helpful: which flowers (their colour, size, corolla tube length and habitat) are preferred by which butterfly species? Are different flowers and resources used in different seasons? Which plant families are used more? Which floral characters are constant among the plant species that are used? Are certain resources shared with other insects or birds?

We know very little about nectar preferences of butterflies under natural conditions. With some laboratory facilities to analyze nectar composition, as might be available in senior colleges and universities, the following observations can be made: do specific flowers that attract a number of butterflies have a unique nectar composition as compared to those flowers which attract fewer butterflies, or no butterflies at all? Do butterfly species that consistently co-occur on certain flowers share their preferences for certain nectar composition? Or do flowers attract butterflies for reasons other than their nectar composition and do butterflies also visit flowers for reasons other than this?

2c. Basking and Daily Activity Periods Butterflies are cold-blooded, so they can regulate their body temperature only through behavioural means. They cannot produce enough heat through metabolism to maintain a constant body temperature, as humans do. Instead, they depend on the ambient temperature. A night's cold may lower their body temperature so that their physiological processes get slower. Therefore, they bask in the sun in the morning and then may do so intermittently throughout the day. Blood circulates through the veins of the butterfly wings and there it warms or cools faster. Therefore when basking, the blood in the veins gets warmer first, which is then circulated to other parts of the body. Once the body temperature is elevated to a level where all physiological processes can take their normal course, the butterflies start their activity. On the other hand, at noon on very warm days the Grass Yellows in open areas go to rest on the undersides of herbs and grass, where a little shade and some cool spots may be found. However, only adult butterflies can bask, the caterpillars may often have neither access to sunny spots nor the freedom to use them, because their adaptations to escape predation prevent them from being exposed.

Dark surfaces heat up quicker than light surfaces and the dark scales of butterflies are more efficient at trapping heat. Swallowtail butterflies are more or less black. Most Brush-footed butterflies are dark. Usually Skippers are dark brown or black. However, Whites and Yellows would seem to have a basking problem, since they are predominantly shades of whites and yellows that reflect heat. They have solved the apparent problem by developing dark bands or profuse black dusting along the veins or in general on the undersides of the wings. The Common Gull, Common Jezebel and Indian Cabbage White are prominent examples. Comparatively, Blues have probably no special arrangement to raise their body temperature, save their narrow, black wing margins and black spots on the undersides.

In some species (for example, the Common Evening Brown and Common Gull) the basking behaviour is complemented by wing colouration. The wings have darker markings during cooler periods of the year and lighter

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markings during the warm periods. This seasonal variation in colouration produces distinct seasonal forms, which are discussed in section 2g: Seasonal Variation in Colouration and Form.

The most widespread style of basking is by spreading the wings flat, as in Brush-footed butterflies and Swallowtails. However, while basking, the former do not cover their hind wings with their fore wings, hence more of their wing area is exposed. Since the peninsular Indian Whites and Yellows have black markings, usually on the undersides, most of them rarely sit with their wings spread. They can expose only one side at a time to the sun and in order to trap the maximum heat, they may slightly lean in the opposite direction to the sun's rays. Skippers are the odd ones out, for they spread their hind wings flat and hold their fore wings at an angle to them. This exposes all their four wings to the sun's rays, but in different planes and on different sides of the wings.

The colouration and basking behaviour of butterflies have a profound effect on their altitude usage and daily activity periods. At high altitudes, depending on the amount of melanin on the wings, the butterflies may restrict themselves to altitudes with fine boundaries defined by even a small difference of 100 or 200 m. Such altitudinal limits imposed by basking efficiencies are reported for certain Whites from temperate regions. Because of the constraints on basking established by their colouration, these species cannot survive for long periods at altitudes higher or lower than their optimum. Thus, a butterfly which is too light in colouration and with little dark dusting on the undersides of the wings can start its activity only late and retire early. This effectively restricts its daily activity time and therefore it has less time for feeding and flying. If the resources of the butterflies are slightly difficult to find, so that to find them the butterfly has to travel considerable distances or for a long time, then the butterfly with a short activity period is at a disadvantage.

Basking behaviour has rarely been studied to analyze the daily flying activity of Oriental tropical butterflies. However, there seem to be indications of some patterns, which will be interesting to explore and then systematically study. For example, in the tall evergreen forests of the Anamalais in the southern Western Ghats, the Common Albatross comes to small shrubs and short trees to spend the night. In the morning, the individuals disperse in all the vegetation layers—from herbs to the canopy of the forest. They bask on the uppersides of leaves and then commence other activities. However, they need to bask periodically and therefore stay active in the canopy openings or on paths in the forest, where the penetrating beams of sun-rays keep the air warm. Since they disperse in all the vegetation layers, thus dividing between themselves the basking spots and keep to sunny patches, they can stay active for longer periods in the day. At dusk the butterflies once again come down near the ground to sleep. This relationship between the basking behaviour, daily activity periods and usage of different vegetation layers during different times of the day is probably unique to the tall evergreen forests and needs further observation.

Suggestions for student projects The following information can be gathered by observing butterflies at different times of the day, in different habitats and seasons.

Is there any correlation between the colouration of a butterfly and how early or late it starts its activity? Are dark butterflies active for longer periods than paler butterflies? Are butterflies at higher altitudes active for a shorter time in the day and only for a few months, as compared to butterflies at lower altitudes? Similarly, are butterflies of the same species in the evergreen forests (especially those living close to the ground) active for shorter periods as compared to butterflies in the deciduous forests? Are there predominantly more white butterflies in the open and low-elevation habitats compared to forest and high-elevation habitats?

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2d. Mate Acquisition Strategies The adult animals are faced with the difficult task of finding mates and reproducing successfully. Among male butterflies, the effort of acquiring a suitable mate is divided at two levels: the first is to prepare for mating by gathering enough resources to satisfy the needs of the mate and the second is to actually find the mate.

Some of the important resources for successful reproduction are gathered in the larval stage. However, the larval resources are rich in carbon and deficient in sodium and proteins. Therefore, the adult females have to supplement the stored nutrients so that they can produce more eggs. But the females of many species usually choose a secluded life and, in effect, they cannot gather many resources themselves. On the other hand, there is competition among males to successfully mate with females. The males that cannot mate are evolutionarily doomed because they do not reproduce. Therefore, the males do everything possible to attract the females. This includes offering them the supplementary resources that they need to produce more eggs. The males themselves first acquire the supplements by sucking them up from damp soil patches. This phenomenon of gathering the supplementary nutrients from wet soil is known as mud-puddling (Plate 1, no. 6). Earlier butterfly-watchers believed that the butterflies' mud-puddling was merely to satisfy their thirst. However, recent studies show that this behaviour is more complex.

Swallowtails as well as Whites and Yellows rely more on their sight to locate mud-puddling spots, especially where the butterflies are already settled. During their streamside patrols they are known to halt at wet soil patches where some white and yellowish butterflies are already settled. This could be one of the main reasons why these butterflies form large mud-puddling assemblages. Swallowtails and Whites and Yellows gather for mud-puddling to ingest minerals such as calcium, phosphate, sodium and nitrogen. Blues, on the other hand, crave for proteins and therefore they are attracted towards specific patches that may contain them, such as rotting animals or droppings close to water bodies. To find such treasures, Blues probably depend on their sense of smell. The mud-puddling males spend a long time sucking up nutrients from the wet soil. Then they concentrate the nutrients in compact capsules, which form parts of sperm ejaculates (spermatophores). They pass these capsules as nuptial gifts to the females while they mate. These are then processed by the females and invested in producing more or bigger, nutrient-rich eggs.

In peninsular India, the following butterflies are regular members at mud-puddling sites:

1. *Swallowtails* All the species except the Southern Birdwing, the Roses and the Tailed Jay mud-puddle. These are amongst the most prominent mud-puddling butterflies as they often form their own species-specific groups.
2. *Whites and Yellows* All the species except the Common Jezebel mud-puddle. In the summer, some of them such as the Common Emigrant and the Common Albatross, are quite partial to mud-puddling. They may form huge swarms of several hundred individuals.
3. *Brush-footed butterflies* Almost all species are mud-puddlers. The Sailers, Sergeants, Blue Tigers, Crows, Nawabs and Rajahs are more frequent mud-puddlers. Unlike in the previous two families, the species from this family rarely form large groups of their own, except sometimes the Crows and Tigers. They are usually scattered among solitary Blues and other Brush-footed butterflies.
4. *Blues* This is a mixed group in terms of the mud-puddling habits of its members. The Hedge Blues, Malayan, Lineblues, Sunbeams and Oakblues are bound to be at any mud-puddling site in the deciduous and evergreen forests. In fact, these species are more often encountered there, and in larger numbers

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than elsewhere. The Flashes can sometimes be found there, whereas the Silverlines very rarely visit such patches.

5. *Skippers* Most Skippers can be seen mud-puddling at some time of the year. However, except for some species such as the Brown Awl, Aces and Chestnut Angle which can be seen mud-puddling regularly, they visit the sites rarely. They neither form their own groups nor join those of other species.

After the supplementary resources are gathered, the males need to find mates. Two mate-finding strategies: perching and patrolling, are both widespread across species, habitats and geographical regions. The perching males select prominent posts where the chances of encountering females are the highest. There they wait for the females to arrive and court them when they do. In many species, the males have regular patrolling routes, often along streamsides and ridges on the hills, on which they patrol looking for females. Perching and patrolling strategies have evolved probably in response to the peculiar ways in which the larval and adult resources are dispersed. Perching is suspected to pay off when the larval and adult resources are found in different patches, or when the resources are more or less uniformly dispersed in an area. Patrolling is favoured probably when the resources are patchy. There, the females keep to specific resource patches and the males move across the patches looking for them. In all likelihood, females also have the same mate locating strategies as males but those in the males are well known. However, in most butterfly species the females probably have the complementary strategy to the males so that their behaviours are compatible. For example, if the males patrol, the females are probably sedentary. Similarly, if the males perch, the females actively move about in search of nectar and larval host plants and during this search they come across the perching males.

Male butterflies are more colourful and this probably helps them to a great extent in attracting the females. An interesting fact is that butterflies have a very high wing area relative to body size, especially when compared to other insects. The better fliers such as flies and mosquitoes and the poor fliers such as the praying mantis and beetles, both have smaller wings. These insects rarely have vivid markings on their wings which could be used in displays for their potential mates. Butterflies, on the other hand, often have peculiar patterns on their wings for attracting their mates and displaying to them. Therefore, the butterflies seem to have evolved a high wing area relative to their body size to enhance the visual appeal to their mates. It is also interesting to note that Skippers, which are mostly dull owing to their predominantly black and brown colouration, have the smallest wing area to body size ratio. In these butterflies visual displays may play little or no role in mate attraction compared to other butterflies.

The prominent colouration among butterfly species follows some family-wide and subfamily-wide patterns. For example, Swallowtails are predominantly black with yellow, blue and green markings. Blues are mostly blue on the upperside and brown or grey with darker markings on the underside. Whites and Yellows are usually white and yellow marked with orange and black. Browns are brown with large prominent eye-spots. These patterns probably have something to do with the butterflies' mate attraction behaviour.

The colouration patterns in certain forest butterflies have been shown to vary in response to the height at which the species fly and different light conditions in the multi-storeyed forests. Their colours make the butterflies prominent at the heights at which they fly and this probably facilitates the attraction and acquisition of mates in these butterflies.

Suggestions for student projects Mud-puddling is a very common phenomenon in the tropics. Since no serious work has so far been done on mud-puddling in Indian butterflies, even simple descriptive information

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will be valuable. For example, which species assemble at mud-puddling sites? Do size, habitat preferences or other attributes of the butterflies influence frequency of mud-puddling? In which season is mud-puddling activity at its peak? Does the peak vary in different species? Which species form groups, which mud-puddle solitarily? Which species consistently form single-species mud-puddling assemblages? Are butterflies from particular habitats more partial to mud-puddling?

Careful records of date, time, number of butterflies and species involved, habitat and micro-habitat where the observations on mud-puddling are taken, etc. will be very useful in interpreting these observations.

Since mud-puddling spots are small in size and limited in number, manipulative experiments can be easily carried out. The experiments can be designed to answer the following or similar questions: Which minerals attract butterflies? Which minerals are preferred by which species? Is there any variation in preference by the same species in different habitats?

Studying the resource dispersion in an area and how butterflies move about the resources or resource patches can test whether perching and patrolling have evolved in response to peculiar distribution patterns of adult and larval resources.

2e. Within-species Colour Variation or Polymorphism Many butterflies have more than one form. You see one, then the other and think they are different species. They are not. They are just different colour forms (rarely also changing their wing-shapes) of the same species. Within-species colour variation is either dimorphic (two forms) or polymorphic (more than two forms), together forming the following categories: 1) Sexual Dimorphism, 2) Seasonal Dimorphism, 3) Polymorphism and 4) Individual Variation.

i) Sexual Dimorphism Sexual dimorphism is common in all five butterfly families. It is more pronounced among Blues, Whites and Yellows and certain Brush-footed butterflies. Apart from colour variation, the two sexes can also be different in secondary sexual characters. Thus, the males may have scattered patches of woolly scent scales or their pouches, because of which they may look different from the females. However, these differences are usually minor.

Among most species of Blues, the sexes are markedly different in terms of brilliance of the scales. The males have very bright blue or orange wings (green in some Himalayan species) with narrow black borders. The females are dull blue or brown, with broad black or brown borders. The upper sides of male Sunbeams are bright orange-red, while those of the females are black and white, but they share a similar pattern of markings on their silvery-white undersides.

Among Whites and Yellows, the Emigrants, Clouded Yellows and Albatrosses show a distinct sexual dimorphism. The females of all these species have more extensive black borders or markings. They are also usually more heavily dusted, with fewer bright colours, and thus very dull in appearance. The Common Emigrant female has additional markings in the cell on the fore wing. The two sexes have different colours in the Mottled Emigrant and Nilgiri Clouded Yellow. The Common Albatross and Striped Albatross males are white and the females bear extensive black markings.

Some palatable butterflies mimic unpalatable butterflies to escape predation and in these species the sexes look entirely different. This is a very effective survival strategy and is discussed in section 2k: Adaptations to Escape Threats: Unpalatability and Mimicry. Information on why male butterflies are usually more attractive is given in section 2d: Mate Acquisition Strategies.

ii) Seasonal Dimorphism Some species from a few groups of butterflies show distinct seasonal forms which may be completely dissimilar to each other. In technical literature this seasonal variation is termed "polyphenism"

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and is discussed in this book in section 2g: Seasonal Variation in Colouration and Form.

iii) Polymorphism Occasionally, butterflies have more than two forms. Polymorphism in peninsular Indian butterflies can be classified into two categories: sexual polymorphism and racial polymorphism. The Common Mormon is a good example of sexual polymorphism. It has four forms: a male form, a male-like female form, a form mimicking the Common Rose and yet another form mimicking the Crimson Rose. The northeast Indian Great Mormon (*Papilio memnon* Linnaeus) is a step further, with the maximum number of forms reported for a species. It has four male and nine female forms! Some of the female forms co-occur and they may mimic unpalatable species occurring in that area. The driving forces in evolution of sexual polymorphism and its advantages, are discussed in section 2k: Adaptations to Escape Threats: Unpalatability and Mimicry.

Although there are racially polymorphic butterflies in peninsular India, a superb example is from the Western Himalayas: the Indian White Admiral (*Limenitis trivena* Moore). This butterfly has five forms, which are geographically separated from each other by gigantic mountain ranges. Thus, due to geographical isolation the species formed races, which then probably changed colouration and pattern to suit local environmental conditions and possibly to suit the preferences of their mates.

iv) Individual Variation This is in a way similar to polymorphism, where individuals of a species have more than two colour patterns or markings. However, these patterns are not constant and heritable, so they cannot be called 'forms'. Given the diversity and unpredictability of appearance of these patterns, they should be treated as individual variations. The Blue Oakleaf (*Kallima horsfield* Kollar) and Common Evening Brown are good illustrations of this phenomenon. The colour and markings of these species have a basic plan, but individual patterns are formed by a lack of certain markings and various combinations of the markings that are expressed. Individual variations are observed in species that heavily depend on camouflage. The individuals of these species need to blend with their surroundings, which vary widely. Moreover, if a camouflaging pattern is without variation, the predators may develop a 'search image' for it. Predators with a well-formed search image can locate even well-camouflaged insects. However, individual variations in camouflaging patterns prevent the formation of a search image and thus this variation is of great survival value. Of course, these butterflies always rest with their wings closed and they need protective markings on their undersides. It is therefore noteworthy that although colouration and pattern on the undersides in these species have run riot, their uppersides have similar markings, following a more orthodox pattern of within-species variations (Also see section 2k. Adaptations to Escape Threats: Camouflage).

2f. Flight Periods and Seasonality Butterflies are seasonal in their occurrence. They are common for only a few months and rare or absent in others. The seasons when they are not active as adults are usually spent either as caterpillars or as pupae. The months when the adults are active are called the "flight periods". Distinct flight periods naturally imply seasonality of the early stages of butterflies as well. Thus eggs, caterpillars, pupae and adults may occur in different seasons. However, this clear-cut pattern of no-overlap or little overlap between the stages is usually characteristic of very cold as well as very warm and dry areas in the world. Since in these areas the growing season for plants and activity period of butterflies are very short, the butterflies can produce only one or two broods per year. These butterfly species are technically termed "univoltine" and "bivoltine", respectively. In the southern Western Ghats and other tropical, less seasonal evergreen forests, the butterflies may produce

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many generations per year ("multivoltine" species). In the multivoltine species, since there are many generations per year, overlapping generations occur and thus individuals of all developmental and adult stages are simultaneously found. However, even in these forests there are hardly any species which do not display seasonality. Very widespread and abundant species such as the Common Emigrant and Common Albatross also show marked seasonality.

Although all butterflies are necessarily seasonal, it is not true that all butterflies in cold and dry regions are univoltine and bivoltine and those in the tropics are multivoltine. Thus, in the tropical deciduous forests the Spot Swordtail produces only one or two broods in a year. Surprisingly, in peninsular India its flight period is restricted to the hottest months of the year—late February to May, peaking in March and April. This is the time when most other butterflies remain dormant. The Spot Swordtail adults emerge from dormant pupae and reproduce. The next generation may also breed and its caterpillars pupate. This batch of pupae remains dormant for almost eight or nine months. The adults emerge the next year. As is evident from the flight periods of other deciduous forest butterflies, monsoon to early winter is a more favourable period for butterflies in these relatively dry forests. Why the Spot Swordtail has evolved a very odd and restricted flight period is as yet unknown.

Various factors are responsible for seasonality among butterflies, but three seem to be decisive: i) availability of larval host plants, ii) availability of the plant in its correct growth stage, and iii) suitable temperature and humidity. These are discussed elsewhere in this chapter.

The same butterfly species behave differently at different altitudes or latitudes. This change in seasonal behavior is suited to life in their local environments and to adjust to yearly climatic fluctuations. A very interesting example of altered seasonality in different geographical locations is that of the Plain Puffin. This butterfly is distributed from Coorg southwards in the Western Ghats and then in the Himalayas and northeastern India. In the south it produces many broods per year, the adults being active from late monsoon through early months of the next monsoon. This butterfly somehow reached Pune city (near northern Western Ghats) a couple of years ago and there it produces a single brood per year, being active only for one or two months in the post-monsoon. It is noteworthy that its flight period is considerably reduced in the drier, less vegetated northern parts of the Western Ghats.

In certain cities of southern India (for example Bangalore and Tiruvananthapuram), previously unreported butterflies are being recorded or previously uncommon butterflies are becoming common (for example the Common Palmfly, Common Banded Peacock and Common Jay). Their flight periods will be interesting to explore and compare with those in their original habitats.

In India, relatively little work has been done on seasonality of the early stages of butterflies. T R Bell's study of butterflies of Karwar and their early stages stands out as a singular effort that included anecdotal notes on flight periods as well as seasonality of early stages. More studies on seasonality and flight periods are needed in our region, especially in areas where disturbances such as fires, grazing or logging are common, or in areas with extreme weather conditions.

Suggestions for student projects The following questions pertaining to seasonality can be addressed while studying local butterfly populations: Which butterfly species have distinct and short flight periods and which species do not? Is seasonality related to the phenology of the larval host plants and adult feeding plants? Do flight periods coincide with major seasonal changes, such as the beginning or end of the monsoon? To study these, weekly or fortnightly counts of butterflies on certain paths of fixed distances will be useful. Along with the numbers of species and individuals, a record of mean daily temperature and humidity will also be

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useful; these can be acquired from the nearest established source. Also, note the phenology of the larval host plants of the butterflies that are being studied and which species use which nectar or other food sources in which seasons. Whether the recorded individual butterfly specimens were fresh or old may also prove to be crucial in interpreting patterns of seasonality.

In the case of butterflies that have recently established themselves in new areas and habitats, it will be interesting to monitor their flight periods in the new as well as original areas and habitats, to compare between the two. In the newer areas do the flight periods lengthen or shorten? Do the number of dry months and availability of host plants in the new area have any effects on the altered flight periods?

2g. Seasonal Variation in Colouration and Form Many species of butterflies, especially Whites and Yellows (for example, the Grass Yellows, Common Emigrant and Plain Puffin), Browns (for example the Bushbrowns, Evening Browns and Rings) and other Brush-footed butterflies (such as Pansys) exhibit seasonal variation in form and colouration, technically termed *polyphenism* (*poly* = many, *phene* = form). In peninsular India, distinctive wet season forms may occur during the wet season, that is, the monsoon and immediate post-monsoon and dry season forms during the rest of the year. In some species the seasonal forms are so different from each other that they had been considered, by mistake, as separate species. Thus, the Spotless Grass Yellow was once considered to be two distinct species: *Terias venata* (Moore) and *T. laeta* (Boisduval). *T. venata* was bright yellow with insignificant dusting on the underside of the wings, and the tips of its fore wings were not pointed. *T. laeta*, on the other hand, was dull with heavy dusting on the underside of its hind wing, the dusting forming two bands, and the tip of its fore wing was pointed. In 1931, Colonel Mosse reared caterpillars from a single batch of eggs laid by a female *T. venata*. This batch yielded two *T. venata* and five *T. laeta*, and therefore these two "species" were pronounced the wet and dry season forms, respectively, of *T. laeta* (now *Eurema laeta* Boisduval).

While details vary, there are certain features in which wet and dry season forms usually differ. As compared to the dry season forms, the wet season forms tend to be darker with more markings, smaller in size and metamorphose more quickly. There is some experimental evidence that these differences in form reduce predation pressure. The paler and unmarked or drably-marked dry season forms of the Common Evening Brown and Peacock Pansy are indeed well-camouflaged in the dry leaf-litter. However, other theories that the eye-spots of the wet season forms help in camouflage by their resemblance to raindrops seem far-fetched. Experimental research also suggests that the darker wet season forms are more efficient at absorbing heat from the sunlight in the cool monsoon season, while the paler dry season forms are better at losing excessive heat in the warmer season.

What environmental cues determine the switch between these seasonal forms? These could be changes in length of the day and temperature range, and also the water content of the leaves on which the caterpillars feed. The caterpillars probably do not react to a relative change in water content over their lifetimes, but respond to it being above or below some threshold.

In peninsular India, seasonal variation in colouration and form occurs in the following groups:

1. *Browns (Satyrinae)* Most species exhibit seasonal variation. The wet season forms are marked with eye-spots (Bushbrowns, Evening Browns and Rings) and white bands (Bushbrowns). The dry season forms lack these. The Common Evening Brown is the most striking example, because its wing shape also changes with seasonal forms. In the wet season form, the tips of the fore

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wings are rounded and not produced. In the dry season form, they are angular and produced to a point.

2. *Brush-footed butterflies (excluding Satyrinae)* Rare, but very prominent in certain groups such as the Pansys. The Pansys have undersides richly marked with lines, spots and eye-spots. In the dry season form, these markings vanish or reduce in extent. In the Chocolate Pansy and Peacock Pansy, the dry season forms have the fore wings and hind wings more produced at the tips, and there is usually a dark or faint line at the centre of each wing. Due to this, the dry season forms, when sitting with their wings closed, resemble dry leaves. In the Common Leopard, the underside of the dry season form is more glossed with purple. The dry season form of the Tamil Yeoman has a white line on the underside. In other Brush-footed the butterflies, differences between the seasonal forms are subtle. Seasonal variation is absent in the Tigers and Crows.
3. *Whites and Yellows* Seasonal variation is widespread and very striking in Grass Yellows, Albatrosses, Puffins, Common Emigrant, Gulls and Orange Tips. The wet season forms are brighter, heavily marked, and dusted. The dry season forms are dull, lightly marked and sparsely dusted or not dusted at all. The most remarkable case is the Spotless Grass Yellow, which, apart from changing markings, also has a different wing shape in the dry season form as compared to the wet season form (see the illustrations under the Common Grass Yellow). The dry season forms of the Common Grass Yellow and Three-spot Grass Yellow have a brown blotch at the tips of the fore wings.

Seasonal variation in colouration and form is usually absent or very subtle among Blues, Skippers and Swallowtails. However, the dry season forms of the Common Cerulean and Lime Blue are strikingly different from their wet seaon forms.

Suggestions for student projects Seasonal variation in colouration and form in butterflies can be studied through some simple observations added to the information on local mean daily temperature and humidity. To begin with, a list of species that show seasonal variations can be prepared. With regular observations in an area, it should be possible to see whether or not the seasonal forms are distinct and non-overlapping. For example, the Bushbrowns usually show intermediate forms between dry and wet season forms. Is this also true for other species? What changes in ambient temperature and moisture occur when butterflies change between the forms? Is there any difference in tendency towards forming the of seasonal forms between butterflies whose caterpillars feed on grasses and herbs versus those that feed on shrubs and trees?

2h. Migration and Local Movements The long-distance migrations of ducks, cranes and other water-birds that visit India from Siberia and Europe are well-known. People more acquainted with wildlife will also be aware of the Monarch butterflies that travel between northern and southern United States, some individuals straying across the Atlantic Ocean to reach the coast of Europe. However, very few would know that some Indian butterflies also regularly migrate, sometimes in very large swarms. Hordes of Cabbage Whites, Painted Lady and Clouded Yellows migrate within temperate regions, and Tigers and Crows within peninsular India. The availability of larval host plants has been proposed as a plausible reason for migrations and local movements of the butterflies. The butterfly caterpillars, while feeding, can sense how much food is available to them and may have evolved to react to shortage or abundance of host plants in the future. If their food is going to be in a short supply, so that the emerging adults would be better off migrating, then the growing caterpillars start preparing so that they can migrate the day they become adults.

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The physiology and morphology of the emerging individuals is thus influenced at the caterpillar stage, and the emerging butterflies are destined to migrate to new areas. However, it is still a mystery how butterflies assemble and decide in which direction they should fly, so that the new areas they reach will have plenty of food for their caterpillars.

The availability of larval host plants may not be the only or even the most likely explanation for migrations. Many butterflies migrate out of areas that harbour enough food. Or they do not stop in areas *en route* where enough food is available for the caterpillars. Instead, they go to a place farther away and all crowd there. Therefore, it is likely that in many instances factors other than the shortage of larval host plants are responsible for migrations. It is sometimes proposed, although this seems unlikely, that present-day migrations are a result of response of butterflies to climate of the last ice-age. Probably the conditions in the ice-age were such that the butterflies needed to periodically migrate, either to escape climatic adversities or due to other factors such as the seasonal availability of host plants during that distant past. The butterflies still continue to migrate out of instinctive compulsion, rather than present-day need.

In India, the following species have been reported as regular migrants: the Lime Butterfly, Common Emigrant, Mottled Emigrant, Common Albatross, Common Indian Crow, Dark Blue Tiger, Blue Tiger, Striped Tiger, Great Eggfly, Painted Lady and Pea Blue. The local movements of the Pea Blue and Painted Lady are also known. However, local movements may be very difficult to detect as these may be diffused, involving very small groups, if any. The migrations of the Dark Blue Tiger and Blue Tiger from southern India are slightly better known. These butterflies form large swarms in which Crows and other Tigers also join, and they migrate across southern India from the plains of the east coast to the Western Ghats. The migrations take place in December. However, the exact causes of these migrations are not known, and dependable estimates of how many individuals participate are also lacking.

Suggestions for student projects We know precious little about the migrations of our butterflies. This is because studying migrations is a long-term affair, and demands co-ordination between butterfly-watchers spread over a large region. Only then can the magnitude and geographical coverage of migrations be estimated. If such a network is established, information can be gathered on which species migrate at what time of the year, where the migrating flocks assemble and where they go. Also, the local movement patterns of certain butterflies can be traced, especially those that are important as crop pests. The species that can be carefully looked at to study patterns of migrations include the Tigers, Crows, Emigrants, Common Albatross, Painted Lady and Pea Blue, which are regular migrants in peninsular India.

2i. Population Ecology The population of an animal in an area is the total of all the individuals of that species put together. It therefore includes individuals of all age groups and both sexes, just like in a human population. It is composed of three age groups: 1) juveniles and sub-adults, 2) potentially or actually reproducing adults, and 3) post-reproductive adults. Of course, these groups are formed by two sexes: male and female.

i) The Two Sexes Ideally there should be 50% males and 50% females in a population. When whole batches of butterfly eggs are reared under controlled laboratory conditions, they usually yield this or a very similar sex ratio. However, in nature, one sees far more males than females (or in rare cases, *vice versa*. For example, see the Indian Palm Bob). Previous studies tell us that in nature females may number as little as 16 to 20% of the population size of adult butterflies. Are the females really so rare as compared to the males? Some studies reveal that in certain butterfly species in which males outnumber

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females, the females suffer higher mortality in larval and pupal stages. The larval stage is very vulnerable to predation and parasitization, and since in these species females are more affected in this stage, the males, as adults, begin with a numeral dominance over the females. When the females successfully complete the developmental process, they usually fly less, occupy shaded places, and are therefore noticed less often. The adult males, on the other hand, fly in more open areas and fly for longer periods. The males, therefore, may not only actually be more abundant, they may also be easier to catch. However, because of this, the predators of adults may take a heavier toll on the males, and thus the males may be destroyed faster in this stage. However, the males still remain far more abundant than the females. However, in some butterfly species the males are only as abundant and as easy to catch as the females. In such species, the two sexes probably do not suffer differential mortalities in different developmental stages. The Common Palmfly, Common Emigrant and Common Albatross are butterflies in which the males far outnumber the females, while in the Tawny Coster and Common Rose both the sexes occur roughly in same proportion. At the other extreme, are the Common Baron and Redspot Duke, in which the females are more common.

ii) The Age Groups There need not always be clear distinctions between the three age groups, especially between the last two. In many animals, for example: birds and mammals, the three age groups are functionally and ecologically similar. That is, they usually eat similar food, occupy similar habitats, and are preyed upon by similar animals. The butterflies, on the other hand, have ecologically different early and adult life stages. They have sedentary, leaf-eating larval stages, and winged, free-ranging adults that feed usually on nectar (but see section 2b. Feeding: Adults). In all the cases, the larval resources are different from those of the adults. As long as the larval and adult resources are found close together and in sufficient quantities, the adults need not fly far in search of these resources. When the habitats fragment, thus reducing densities of resources or increasing distance and discontinuity between the resource patches, the butterflies tend to fly more or disperse to neighbouring areas. This produces a different population structure (i.e., proportion of individuals in different growth stages) than the one which is harboured in a relatively larger habitat patch or a contiguous habitat. On the larger habitat patch, the population fluctuates within some limits, and a certain proportion of adult butterflies to caterpillars is maintained, which, again, varies within some limits. On smaller patches deficient in resources or where resource availability is fluctuating and unpredictable, the populations fluctuate violently. The patches sometimes get overcrowded, or more often, the populations get temporarily extinct. Here, the populations may consist predominantly of adult butterflies or caterpillars (this can happen seasonally and in larger habitats also; see section 2f: Flight Periods and Seasonality). Such populations may demand an input of individuals from other habitat patches, which will be discussed later in this section. Studies on European *Hesperia comma* suggest that the morphology of adult butterflies is different in contiguous and fragmented habitat patches. The butterflies in fragmented habitats invest more in thoracic mass (reflecting their ability to disperse). The butterflies in contiguous habitats invest more in abdominal mass (reflecting investment in reproduction). The trade-off is clear. In a contiguous habitat, the butterflies need not travel long distances, so if they invest more in reproduction, they would leave behind more eggs, and hopefully, many reproducing offspring. On the other hand, the butterflies would benefit in fragmented habitats if they invest more in thoracic mass which would aid in long-distance dispersal. The dispersing butterflies may end up in the wrong places. However, if they land in the right habitat

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patches which are as yet unoccupied or sparsely inhabited, and even if they lay only a few eggs, in the long run they and their descendents may produce more offspring.

When do adult butterflies need to travel far, and whenever they need to, where do they go? Very rarely is a butterfly's habitat homogeneous and contiguous with adult and larval food sources placed together. In many cases, it is divided into distinct patches of larval host plants and adult feeding resources. Since the larval stage is sedentary, the adult female butterflies have to find appropriate and safe places for their caterpillars to grow. Additionally, the male and the female have to find enough resources for themselves. If the males do not get enough pollen, nectar or minerals (mostly sodium), the females may reject them as their mates. If the females do not get enough nourishment in their larval and early adult stages, they cannot lay as many eggs as they can if sufficiently fed. So the butterflies have to shuttle between larval and adult resource patches. Studies on the Apollo butterfly (*Parnassius apollo*), which is found in temperate Asia and Europe, showed that its habitat is composed of larval and adult food patches, and the butterflies may have to travel more than one-and-a-half kilometers in search of the larval host plant or the nectar source. Another study demonstrated that patches with more flowers received more Glanville Fritillary butterflies (*Melitaea cinxia*), and the butterflies stayed longer on such nectar-rich patches. Reproduction, of course, occurred only where the larval host plants were available. Thus, a butterfly population is usually divided into a sedentary and inconspicuous larval component, and a mobile and conspicuous adult component, which may be separated in two different but relatively closely-placed patches.

Sometimes a butterfly population is divided into two different, geographical units. In this case, one unit may be very large, with a large reservoir of adult and larval resources. This unit, due to its abundant resources, may produce surplus butterflies. The other unit may be small or with sparsely distributed resources. Because this unit has a dearth of resources, it may not produce even as many individuals as are necessary to avoid inbreeding and possible eventual local extinction. The first, larger unit here is a 'habitat mainland' and the second unit is a 'habitat island'; so called due to their relative sizes and relationships with each other. The habitat mainland acts as a permanent 'source' and provides the habitat island with the surplus individuals that it produces. The habitat island, on the other hand, is a home, a "sink", where the butterflies which have migrated from the habitat mainland settle. In the long term if a butterfly population in the sink or habitat island survives, it is due to the supply of individuals from the habitat mainland. The habitat mainland and island are separated by a non-utilizable area in between them: the 'matrix'. It separates the habitats embedded in it into two or more patches.

According to another version of this theory, there need not be distinct and rigidly defined habitat mainlands and islands. There could be several patches, large and small, among which the butterflies move randomly. Thus, each habitat patch is simultaneously a habitat mainland and a habitat island in the above sense. The chance that a butterfly population in a specific habitat patch becomes extinct depends on: 1) its size, 2) amount of resources or resource density, 3) frequency of butterflies arriving on that patch (which is proportional to area and shape of the patch), and 4) frequency of butterflies leaving the patch (which is affected by density of butterflies on that patch relative to the density of resources). According to this view, each habitat patch has an independent or dependent population. Together, all the habitat patches support a larger, unified population: a *metapopulation* (*meta* = of a higher kind).

iii) The Population Fluctuations A few butterfly species, for example, the Common Tinsel (*Catapaecilma major* Fruhstorfer) in the Nilgiri mountains (Tamil Nadu–Kerala)

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and the Great Blackvein (*Aporia agathon* Gray) in the Simla Hills (Himachal Pradesh), are abundant for a few years and then gradually decline in abundance. Such long-term population fluctuations, their exact patterns and causes, are poorly reported from India, primarily because very few people at present work on butterflies. In England, where butterflies have been closely monitored for the last 25 years, the patterns are becoming clearer as the years pass. A few species that are being monitored have shown a ten-fold increase or decrease in numbers. However, the causes of fluctuations are still a matter of speculation. It will perhaps take many more years of monitoring the butterfly populations and correlating their trends with climatic data and human land-use patterns, before something conclusive can be said. These studies, and those on moths in Europe and North America, show that fluctuations in numbers may be driven by, or at least correlate with, the following factors:

1) Fluctuations in abundance of host plants: this may in turn depend on various factors such as rainfall, annual temperature range and human land-use pattern.
2) Density-dependent destruction by parasitoids: when the caterpillars of butterflies or moths are more abundant, the parasitoids find it easier to discover and parasitize more caterpillars. Thus, they build their own population more rapidly and finally bring down population size of the butterfly or moth. When the caterpillars get less common, the parasitoids also decrease drastically in abundance. This produces cyclical population fluctuations in both the butterfly or moth that acts as the host and the parasitoid(s).

Suggestions for student projects Studying aspects of butterfly populations is a project an amateur butterfly-watcher can easily undertake. There are many aspects that can be looked at either by rearing caterpillars or simply observing adult butterflies in the field. In many butterfly species, especially Skippers as well as Whites and Yellows, male and female can be identified in the caterpillar stage itself. The male caterpillars have a pair of small yellow spots on the upperside of their abdomen, corresponding to their testes. Using this clue, a large number of caterpillars of various species can be reared both at home and in the field to check sex ratio of those species: 1) at conception (proportion of male to female when the caterpillars hatch from the eggs), 2) when the caterpillars pupate, and 3) when the adults emerge. After obtaining the last sex ratio, one can go to the field and check if this is the ratio found in free-living adult butterflies. This will elucidate whether in our butterflies differential mortality among caterpillars of two sexes occurs, as has been reported for butterflies from other regions.

For long-term monitoring of butterflies, the formation of local groups of butterfly-watchers is needed, members of which can regularly visit specific areas to watch butterflies. If records of sightings of all species are maintained for a few years, they may reveal monthly and annual patterns of butterfly population fluctuations which, in turn, reveal long-term population fluctuations.

Also see suggestions for student projects under section 2f: Flight Periods and Seasonality.

2j. Threats to Life The diversity of Indian butterflies (1, 501 species) may be compared to about 1, 300 bird and over 370 mammal species in the Indian subcontinent. Because the butterflies are so diverse in their species numbers, one would expect that they are also omnipresent and abundant, an expectation which is indeed fulfilled. Not surprisingly, they form an important part of nature's food web. Various destructive agents may destroy, depending upon the butterfly species, over 95% of individual butterflies before they reach adulthood. A portion of the population of adult butterflies is consumed by birds, lizards and spiders. The organisms that destroy butterflies in different stages of their life can be divided into three main categories, based on the way they feed upon the

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butterflies: i) parasitoids, ii) parasites, and iii) predators.

i) Parasitoids (Plate 2, no. 11 & 12) Parasitoids are hitchhikers in a novel way. They use the eggs and larvae of insects as capsules on which to feed internally. This is exactly what the parasites also do. However, the parasitoids differ from the parasites in that they are minute wasps and flies, themselves insects, and they parasitize only insects. The female parasitoids, using their special egg-depositors, lay their eggs inside the eggs and larval stages of the host insects. The parasitoid larvae then bore into tissue of their hosts, initially eating the non-vital parts. As they grow older, they eat more of the host tissue and usually by the time the hosts are ready to pupate, the parasitoids also pupate inside or around the hosts' bodies. The host pupae soon die and only the parasitoids emerge. This is the second important difference between the parasites and the parasitoids, that the parasites may or may not kill their hosts, but the parasitoids always do. The newly-emerged adult parasitoids then fly away in search of mates and later the females set of to find new hosts for their larvae. However, parasitization by parasitoids is not all. There are certain *hyperparasitic* (*hyper* = over or above) wasps that are even smaller than the conventional parasitoids. These wasps parasitize the parasitoids, that is, they are parasitoids of the parasitoids! Hyperparasites finally kill the parasitoids as well as the ultimate hosts.

The female parasitoids use several clues to search for the caterpillars to be parasitized. There is an increasing suspicion that many parasitoids use chemical signals sent by plants damaged by the caterpillars. If the caterpillars are present in high densities on the host plants, then more foliage is damaged. The damaged plants secrete certain chemical compounds in higher concentrations and in some cases their neighbouring plants are known to use these compounds as signals. The neighbouring plants then synthezise secondary compounds in their leaves, which make them less palatable. It is possible that the parasitoids also use the same or similar signals and track the caterpillars, which they parasitize.

A factor that is known to affect searching efficiency of the parasitoids is alteration in structure of the habitat of the parasitoids and the caterpillars. When a forested habitat gets fragmented or thinned, the parasitoids can find the caterpillars more efficiently. It is still unknown exactly which clues the parasitoids use, but a study shows that parasitization rates may increase in areas with disturbed vegetation.

When the searching efficiency of the parasitoids increases, the parasitization rates increase. When this happens, larger proportions of the caterpillars are killed by the parasitoids, thus rapidly bringing down population of the caterpillars. As the density of the caterpillars decreases, the parasitization rates also decrease and the caterpillars get some time to build up their population. The population swings in both the caterpillars and the parasitoids continue. These cycles, which are influenced by the density of the caterpillars and parasitization by parasitoids, are known in certain moths that are pests in forestry plantations. Similar cycles are probably widespread in butterflies, too, but are possibly less dramatic.

Parasitoids parasitse most of the butterfly and moth species. On an average, there is probably more than one parasitoid species per butterfly or moth species. An extreme example of species-specific diversity of parasitoids is found in a teak defoliator moth: *Hapalia machaeralis* Walk (Pyralidae). Over 90 species of parasitoids are known to infect this moth. Of these parasitoid species, 47 are primary parasitoids of the moth and 46 are hyperparasites, a few also infect other moths. Such parasitiod diversity may be expected at least in some butterflies.

Examples of common butterfly species whose caterpillars are often parasitized include the Tigers, Tailed Jay, Lime Butterfly, Common Mormon and Common Baron.

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Suggestions for student projects For butterflies, parasitoids are perhaps the most threatening of all destructive agents. To understand butterflies, therefore, it becomes necessary to understand various aspects of the biology of parasitoids, the effect of parasitoid infections on butterfly numbers, species-specific parasitoids, parasitoid species diversity, etc. The following observations can be made by extensively rearing butterfly caterpillars at home, with minimum facilities.

Which butterfly species or groups are more parasitized? On an average, what is the parasitoid load and diversity of parasitoids in individual butterfly species? Does the parasitization rate increase with the density of the caterpillars? Which instars are more vulnerable? How common is hyperparasitization?

For all these studies, representatives of different butterfly groups (palatable versus unpalatable species, solitary versus gregarious species, common versus rare species, etc.) can be chosen. Caterpillars in the field, kept under observation as controls, can be protected from the parasitoids by enclosing the twigs on which they are feeding with large polythene sheets or thin cloth bags. If the caterpillars need to be allowed to be parasitized, but kept safe from predators, then a mosquito net or a similar cloth with an appropriate pore size can be used. Species identification of parasitoids is a tedious job, therefore they can be stored in 70% alcohol for identification by experts.

ii) Parasites Various mites, protozoans, bacteria and viruses parasitize all the life stages of butterflies. Some of them also pass from one generation of the butterflies to the next through their eggs. Others may be transmitted in the later life stages of the butterflies. Mites are the main external parasites of the adults, whereas others are internal parasites.

Caterpillars of certain unpalatable butterfly species stay in groups, although many stay alone. Unpalatable caterpillars are boldly marked and therefore their gregariousness and collective mass may amplify warning signals to the predators. However, since certain palatable caterpillars also stay in groups, there are probably other reasons as well for the caterpillars being gregarious. Whatever the exact reasons for the evolution of this gregariousness, increased transmission of parasites within the group can be a cost of forming groups. If one caterpillar gets infected, then it is likely that many more caterpillars will be infected and finally killed. Viral infections are a major cause of mortality in a few gregarious butterfly caterpillars. The Pioneer butterfly is a good example of a gregarious species that loses a major chunk of its population to microbial infections. More than half or, in the worst case, over two-thirds of the caterpillars may die due to these infections.

iii) Predators Predators are a menace affecting all the life stages of butterflies. There are many predatory insects like digger wasps, mason wasps, paper wasps, ants, praying mantids and lacewings (relatives of ant-lions). The ants and lacewings eat the eggs whenever they find any. The wasps hunt and paralyse caterpillars and store them in their nests along with their own eggs. The wasp larvae that emerge from the eggs feed on the caterpillars. A very common predator of lepidopteran larvae is the lacewing larva (order Neuroptera), whose effect on caterpillar populations has probably been underestimated so far. On many larval host plants the lacewing larvae, disguised as tiny worthless heaps of debris, can be found openly roaming to make juicy meals of butterfly caterpillars. They have been actually seen feeding on caterpillars of the Common Emigrant, Common Indian Crow, Common Gull (see Plate 2, no. 7) and Plain Puffin. Praying mantids hunt caterpillars and adult butterflies in their usual way, camouflaging themselves at the spots where butterflies and other insects are more likely to be captured (Plate 2, no. 8). Adult butterflies get entangled in the webs of the spiders, or non-web-spinning, jumping and crab spiders catch them using their methods of jumping and ambush.

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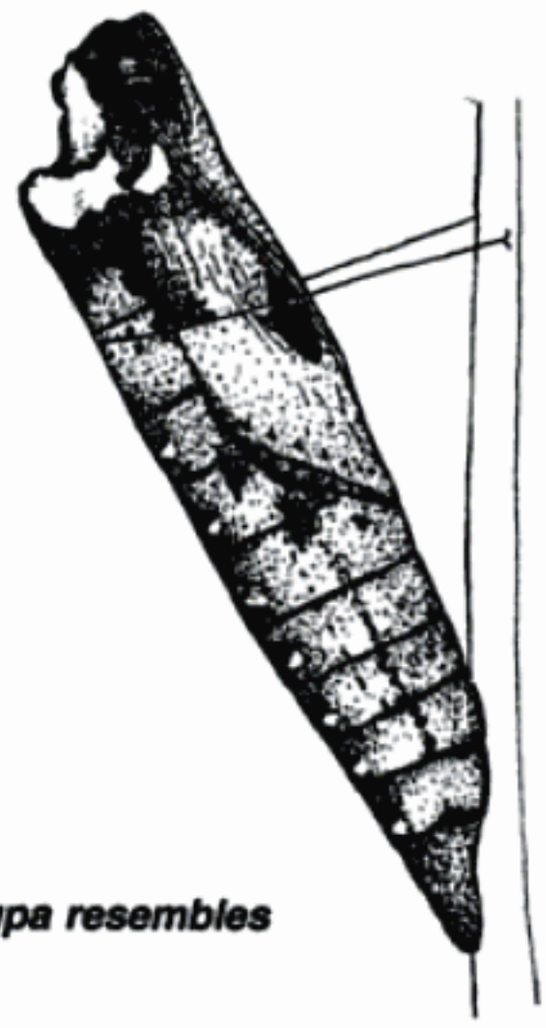
The vertebrate predators also consume their share of the butterflies. Lizards and skinks are effective predators of adult butterflies, which hunt by ambush and surprise attack. Insectivorous and omnivorous birds such as the warblers and bulbuls devour butterfly caterpillars. The bee-eaters capture adult butterflies and sometimes these expert fliers can be a serious threat to passing butterflies.

2k. Adaptations to Escape Threats The story of the passenger pigeon is legendary. Once upon a time, this bird boasted a population of millions. When human greed and profligacy struck, it was reduced to extinction. This is a classic example of global extinction of an animal due to unchecked predation on it. Since butterflies also have so many predators and parasitoids destroying their various life stages, how do they manage to survive? Had it not been for the superb protective colouration and behaviour of the butterflies, perhaps most of them would have perished. Of the most effective survival strategies the butterflies have adopted, four are widespread: i) resemblance to inanimate objects (camouflage), ii) unpalatability due to storage of toxic compounds, iii) mimicry of unpalatable species, and iv) larval association with ants.

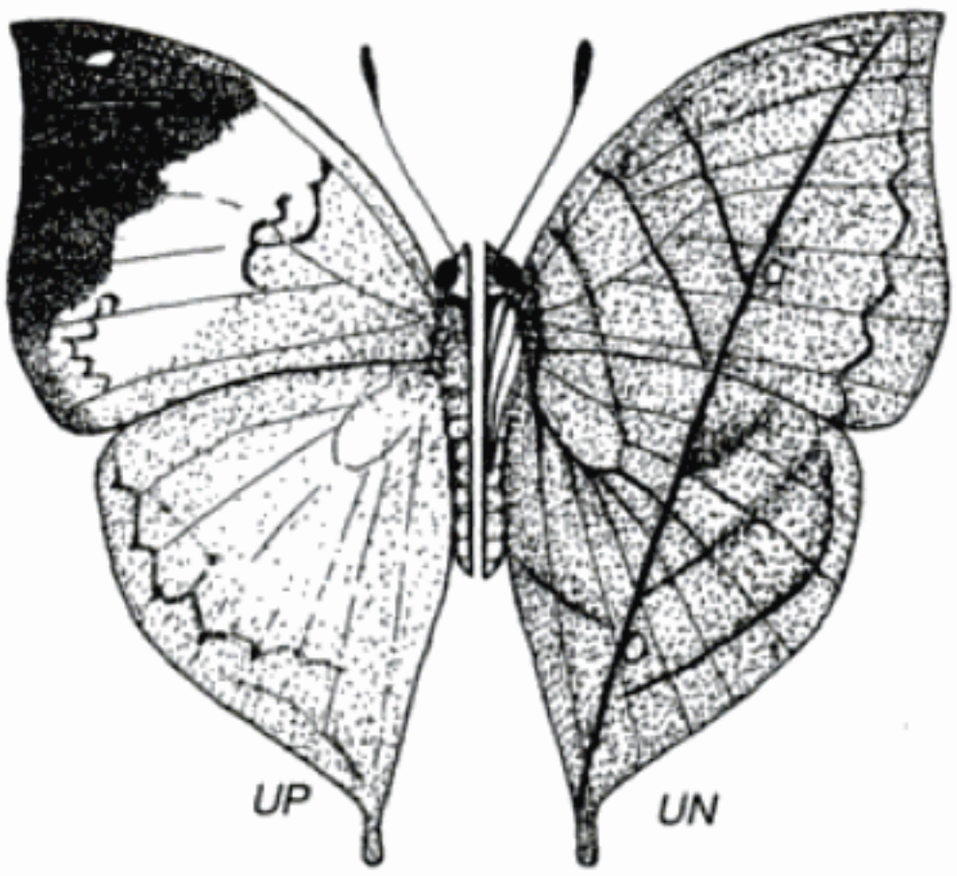
i) Camouflage Camouflage is perhaps the most commonly employed of survival strategies. Many adult butterflies such as the Pansys, Bushbrowns and Evening Browns, camouflage themselves amongst dry leaves. Although usually only adult butterflies resemble specific inanimate objects, in a few rare cases (such as the pupa of the Common Mime, which looks like a dried broken twig) caterpillars and pupae are also well camouflaged. In most cases they are only well-concealed, and therefore difficult to locate, but do not resemble any particular objects (Plate 3, no. 18). Examples of adult butterflies that are cryptically coloured on the underside are almost as numerous as there are palatable butterfly species. The Painted



Common Mime pupa resembles a broken stick

Lady, Oakblues, most Skippers and Spotless Grass Yellow are some prominent examples.

The Blue Oakleaf (*Kallima horsfieldii* Kollar) is a paragon of camouflage. The tips of its wings are produced and pointed and look like the petioles and tips of leaves. Its



Blue Oakleaf

undersides are shades of brown but with variable, individually differing patterns on them resembling those of dry leaves. In fact, its markings resemble even the fungal spots and withered tissues of the dried leaves.

All peninsular Indian butterflies which use camouflage as a survival strategy resemble dry leaves in the leaf-litter on the forest floor. Thus, they mostly occur in forested areas and

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always close to the ground. Many of them have a habit of leaning on one side while resting, and their slanting wings merge superbly with the leaf-litter. They usually fly only when the predator or intruder is very close by and fly unsteadily only for a short distance. Ironically, these butterflies that so heavily count on camouflage and are therefore cryptically marked on the undersides of the wings, may have very attractive markings or colours on the upperside of the wings. Thus, the Common Evening Brown and Bushbrowns have eye-spots on the upperside of the fore wing. The Blue Oakleaf has a broad, pale blue band across the fore wing. The entire upperside of the Peacock Pansy is brilliant tawny-orange. Although these prominent features *attract* the attention of the predators, probably it is precisely for this reason that they have evolved. These markings are never seen until the butterfly starts flying. Therefore, a predator that unknowingly disturbs a resting butterfly can visually follow the attractive markings as the latter darts close to the ground. But then, it abruptly lands and merges with the leaf-litter as it closes its wings. The predator that had no trouble visually following the butterfly by tracing the aerial path of the prominent markings of the butterfly suddenly realizes that the butterfly has vanished. It may go in the direction of the butterfly to search for it once again and in the process only flush it. However, the butterfly gets away with the same trick one more time. The predators would usually become impatient with such butterflies and therefore after one or two attempts they may lose interest in them. To learn about how butterflies use this trick of camouflage, disturb and follow a Common Evening Brown through the undergrowth. The butterfly would be easy to follow as long as it is on the wing,

MIMICRY

Plain Tiger: the unpalatable model

Striped Tiger: the unpalatable model

Danaid Eggfly: the palatable mimetic female (Batesian mimic)

Danaid Eggfly: the palatable non-mimetic male

Tamil Lacewing: the unpalatable Müllerian mimic

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but as soon as it abruptly crashes into the leaf-litter it is impossible to point to the exact spot where the butterfly is sitting. Experience it a couple of times and soon you would find yourself going after an easier-to-catch butterfly. This is how camouflage works for butterflies.

ii and iii) Unpalatability and Mimicry

Unpalatable butterflies are relatively less prevalent as compared to those who use camouflage or association with ants as a way to escape predators. For example, in peninsular India there are close to 350 butterfly species, but not more than 20 are unpalatable. Mimicry, in which palatable butterflies mimic unpalatable ones, however, is even rarer, with only 10 peninsular Indian species following it. Because these butterflies copy the appearance and behaviour of the unpalatable species, the predators are fooled into thinking that these butterflies themselves are unpalatable. Although unpalatability and mimicry are relatively less common, they are probably the most effective survival strategies of butterflies. However, they work against only vertebrate predators, such as birds.

The story of how certain butterflies became unpalatable is a remarkable story of co-evolution and it starts with plants. All plants synthesize various chemical compounds, for example, alkaloids and tannins, which have various functions. Some of them serve as defence against browsing. Most of these deterrents do not endanger the life of the browser, but a few are fatal if consumed in large quantities. A small number of plants possess such toxins, familiar examples of which are 'aak' (*Calotropis gigantea*), oleander, figs, passion flowers and aristolochias. A particular class of compounds found in relatives of aak, the cardiac glycosides, causes the heart to beat more strongly, but slowly, and forces the animal to vomit as a side effect. As a consequence, the browsers avoid eating plants that have cardiac glycosides and there are only a few insects that feed exclusively on their foliage. Some butterfly caterpillars not only feed on these plants, they are specific to them. During their development they store the glycosides in their bodies and the adult butterflies also retain them. We do not know whether the butterflies started feeding on unpalatable plants before or after the plants invented toxic compounds. The chances are that they were feeding on these plant species before as well. As the plants built their collection of toxins, instead of switching to new host plants, the butterflies co-evolved with their old hosts to deal with newer toxins. They not only succeeded in overcoming their toxic effects, in the process, they have also come to employ these plant defences for their own defence.

An important rule in nature is: if you have something worth advertising, advertise it. Therefore, the unpalatable butterflies possess certain characters that signal their unpalatability. They are brightly coloured in reds, yellow-oranges, black and white, or combinations of these. They fly relatively slowly and steadily, even when threatened by predators. They lie motionless if caught. Their bold colours and contrasting patterns help the predator to easily remember them and their slow flight allows it sufficient time to do so. They have also acquired a tough skin that can survive mishandling. This helps, particularly if the bird does remember the toxic butterfly but only after it is caught and pecked at a few times. Some species discharge yellowish, nasty-smelling fluids from the glands present usually on the thorax and leg joints. These act as a repellent.

Feeding on unpalatable plants, storing the toxins and flying slowly comes naturally to a butterfly. However, for a predator, avoiding eating an unpalatable butterfly is not instinctive. In every predator generation, naïve young individuals consume a proportion of unpalatable butterflies, only to learn that the butterflies of particular colouration taste unpleasant. The individuals that consume these butterflies suffer the bitter experience of strong heart-beats and vomiting and from then on avoid eating similar butterflies, even when they are hungry. The

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toxicity of these butterflies is so severe that consuming them even once is enough to teach the predator a lesson for lifetime.

Is it then not beneficial for the unpalatable butterfly species from an area to look similar to each other? If they are similar, they would lessen the burden on the bird's memory of remembering different colour patterns of unpalatable species. In the process, they would reduce the risk of repeated predation on the same colour pattern by a forgetful bird. In fact, it is commonly observed that many unpalatable species from an area resemble each other. The number of species may be large, but the number of designs they display is limited. This type of mimicry, where unpalatable species 'mimic' each other, is called 'Müllerian mimicry', after Fritz Müller who proposed it. Each species involved in this mimicry is known as a Müllerian mimic and together they form a group, called a Müllerian ring. The formation of Müllerian rings is due to the convergence of the wing patterns of many unpalatable species. Occasionally a single unpalatable species could have branched out during the course of evolution to form many species, which continue to retain their original colour pattern.

The process of natural selection would allow convergence or maintenance of wing pattern in Müllerian mimicry, or in fact drive it, because it benefits both the birds and the butterflies. However, Müllerian mimicry confers an additional advantage on the butterflies. In terms of predation pressure, the individuals of all the Müllerian mimic species act as individuals of a single species. This is because a bird that eats an individual of any of the Müllerian mimic species does not eat individuals of any other Müllerian mimic species. To understand this, imagine that there are 10 individuals of an unpalatable species. Out of these, the bird needs to eat one individual to learn the colour pattern to be avoided. Therefore, 9 individuals are left. On the other hand, even if there are 10 similar-looking unpalatable species, each with 10 individuals, the bird still eats only one individual of any species to learn the same thing. Thus, 9 individuals of different species are spared by the bird, which would have been consumed if all the species had different colour patterns. This saves per species an average of 0.9 individuals out of 10, that is, instead of 9 individuals, 9.9 are left after the bird is educated!

Although Müllerian mimics tend to maintain a colour pattern, there is nothing sacred in the pattern itself. Since every generation of birds learns the pattern through experience, it is important that there is a certain wing pattern in the unpalatable species. Locally, regionally, or over time the patterns can change, nevertheless they offer the same degree of protection to the unpalatable species. The important rule of the game of Müllerian mimicry is not that the patterns should involve specific colours, markings or their combination, but that they should be unique to the unpalatable species. There should not be any commonly occurring palatable butterfly species which share the patterns.

Yet, there are a number of palatable butterflies that share with the unpalatable species their wing patterns. However, the wing patterns of the unpalatable butterflies must have evolved earlier. The palatable butterflies would have evolved to resemble the unpalatable butterflies after the latter had established their unpalatability. This resemblance, 'Batesian mimicry' (after a 19th century explorer–naturalist, H W Bates), is a disguise used by palatable species to evade predation, simply by dressing up to appear unpalatable. In this type of mimicry, the unpalatable species are called the "models" and the palatable species that resemble the models, the "mimics" or "Batesian mimics". Without exception, the Batesian mimics are far less numerous than their models and, in fact, their relative rarity is a very important precondition for the evolution and working of this mimicry. Since the mimics are far less common, the inexperienced bird almost always first catches a butterfly of a model species. The bird learns from this first bitter

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experience, remembers the colour pattern of the butterfly and in future avoids this pattern. Thus, the bird, who is 'once bitten, twice shy', so to speak, also spares the mimics.

The palatable butterflies mimic the colour and flight patterns of the unpalatable ones, because these seem to be the easiest to mimic. Batesian mimicry in butterflies, therefore, is visual cheating. In the case of butterflies it works only for the adults, because different predators attack larval and adult stages. The main danger that a caterpillar faces is from parasitoids. The parasitoids find the caterpillars using mostly non-visual cues. Therefore, mere colour mimicry may not work against them. Secondly, caterpillars are host-plant specific and therefore the parasitoids and predators may learn to avoid nasty caterpillars but consume the similar-looking tasty ones feeding on different plants. On the other hand, the adults are not tied to the host plants and are destroyed more by birds and lizards, and a few insect predators, but not by parasitoids. Therefore, any kind of visual cheating helps only adults against predators such as the birds and lizards, which search predominantly by sight.

A prominent feature of the mimics is their switching over between alternative flight patterns. As mentioned above, the flight of the unpalatable species continues to be relatively slow and steady even when predators attack them. On the other hand, the mimics give in easily. They are not as stubborn and persistent in their flight style as their models. Ordinarily they fly like their models, but if threatened, immediately give up the act and fly swiftly away, similar to the non-mimetic species, in a dodging and erratic manner. Try and miss netting a Common Mormon female that mimics the unpalatable Rose butterflies and you will know. The bottom line is, the mimics acquire the style of their models, but not the substance; yet, it helps.

Mimicry among peninsular Indian butterflies The Batesian mimic butterflies and their models are everywhere around us, even in busy cities. Take a look in the garden and you may see one or two of them fluttering over the flowers. Peninsular India has 7 models, 5 Müllerian mimics and 10 Batesian mimics, most of them common species. Among these butterflies, the most striking feature related to mimicry is sex-limited Batesian mimicry. In 7 out of 10 Batesian mimics, only the females mimic the models. The males of these species look different and probably represent the original form of the species. Of the three species that do not have sex-limited mimicry, the Common Mime has two forms. These forms are identical in both the sexes and each form mimics a separate model. However, this species may be a Müllerian, rather than a Batesian mimic of its models. It has boldly colourful caterpillars and this may be indicative of its unpalatability. Thus, there may possibly be only two Batesian mimics, the Painted Sawtooth and the Malabar Raven, in which both the sexes mimic the models. Notably, there is no species in the world in which only the males mimic the models.

Different demands on and advantages to the sexes might have been the major force in the evolution and maintenance of sex-limited mimicry. Usually the males of the species court the females, which select the best possible males as fathers for their future offspring. In many butterflies, the colouration of the males attract the females and the females probably select the males based on the males' specific characteristics of colouration. However, evolutionarily speaking, the females cannot be arbitrary in deciding that a certain male character is 'attractive'. Certain characters are decisive in females choosing particular males, probably because these characters would mean better qualities of the males possessing them. Thus, in butterflies if the criteria used by females for choosing males are such that they do not allow the departure of male colouration from the established, 'preferred' pattern, then the original pattern would be maintained. However, the males usually do not seem to be as rigid and choosy as the females in selecting their mates based

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on their colouration. Therefore, the males may still mate with the females even if the latter look slightly different from their original form. When the differences accumulate, in rare cases the new wing pattern of the females may resemble that of an unpalatable species, that is, the females would become Batesian mimics. The alteration in the wing pattern and behaviour would reduce predation pressure on the females with the new pattern. Therefore, due to reduced predation pressure, these mimetic females would survive longer to lay more eggs. Thus, if the male Danaid Eggflys looked attractive to their females only if they were black and had white spots in specific regions of the wings, then only such males could breed. On the other hand, if the females slowly (in successive generations) diverged from their original, male-like wing pattern and behaviour, to be more Plain Tiger-like, they could reap the fruits of Batesian mimicry. This is what most probably happened and therefore the species is today one of the most perfect mimetic species and a good illustration of sex-limited mimicry. Since the males do not mimic the model, as a price they may suffer greater mortality due to predation. However, the males (the courting sex) retain their sexual appeal while the females (the egg-producing sex) live a safer life to lay as many eggs as is physiologically possible and not imposed upon by high predation pressure.

The sex-limited mimicry gives rise to a problem in certain commonly occurring species. Since the males are not mimetic, they do not affect the mimicry system even when their numbers are very high. The females, on the other hand, cannot become as numerous as the males, otherwise this would increase the risk of predation on themselves and their models. Thus, among the mimics, one may expect the evolution of imbalance in the proportion of males to females, with the males being much more numerous. This imbalance is maintained probably at the level of egg-production, by producing more maleeggs (unlike in human beings, in butterflies the *females* produce two types of gametes, the males only one type. Thus, the female gametes decide the sex of the offspring). For example, in the Danaid Eggfly, the males are more common than the females, the average sex ratio being 1 female to 8 males. This skewed sex ratio does not result from more female caterpillars dying during their development.

One of the commonest Batesian mimics, the Common Mormon, is a remarkable species. The male is black with a series of small white spots. The female has three forms. Form *cyrus* is similar in appearance and behaviour to the male. Form *stichius* mimics the Common Rose and form *romulus* mimics the Crimson Rose. The three female forms may be found together, but their relative abundance varies regionally. The two mimetic forms are common wherever their models are common and their relative abundance changes roughly according to relative abundance of the models. Thus, around Pune near the northern Western Ghats, *cyrus* is uncommon, both *stichius* and *romulus* are common, but *stichius* is commoner because the Common Rose is more abundant. In southern India, *romulus* also is very common because here the Crimson Rose is commoner. In Dehra Dun and Simla, *cyrus* female is the norm because the Roses are absent or very rare in these areas, that is, the Mormon locally has no models to copy. Yet, occasional *romulus* and *stichius* females do surface in the absence of these models. The reason for the mimetic forms being so rare in these areas seems to be precisely that the models are absent and the occasional mimetic individuals are predated upon more easily because they are not protected locally through mimicry. Studies on a North American Swallowtail butterfly have shown that in populations where the females appear in more than one form, the rarer, non-mimetic female form may be maintained because the males preferentially mate with the females of this form. This may be true of the Common Mormon as well.

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The mimic-model butterflies from peninsular India form four major clusters around the model groups: 1) the "tawny" Tigers (after their tawny colour), 2) the "blue" Tigers (after their blue spots), 3) the Crows (after their black colour), and 4) the Roses (after their crimson bodies). The model species and their Müllerian and Batesian mimics are as follows:

Cluster 1: The "tawny" Tigers: 1. Plain Tiger: Müllerian mimics: none. Batesian mimics: Danaid Eggfly female and Indian Fritillary female.
2. Common or Striped Tiger: Müllerian mimics: Tamil Lacewing. Batesian mimics: Common Palmfly female and Indian Fritillary female.

Cluster 2: The "blue" Tigers: 1. Blue Tiger: Müllerian mimics: Dark Blue Tiger and Glassy Tiger. Batesian mimics: Common Wanderer female, Dark wanderer female Common Mime (form *dissimilis*). In this cluster, the Blue Tiger is treated as the model because it is both common and widespread. However, the Dark Blue Tiger and the Glassy Tiger can be more common locally than the Blue Tiger, especially in forested areas. In their preferred habitats, since they outnumber the Blue tiger, they would act as the models, rather than as Müllerian mimics.

Cluster 3: The Crows: 1. Common Indian Crow: Müllerian mimics: Double-branded Crow and Brown King Crow. Batesian mimics: Great Eggfly female, Common Mime (form *clytia*), Malabar Raven.

Cluster 4: The Roses: 1. The Common Rose: Müllerian mimics: Malabar Rose. Batesian mimics: Common Mormon female (form *stichius*), Red Helen female.
2. The Crimson Rose: Müllerian mimics: none. Batesian mimics: Common Mormon female (form *romulus*).

The Common Jezebel has a single mimic in the form of the rare and geographically, restricted Painted Sawtooth. Three unpalatable species, the Tawny Coster, the Malabar Tree Nymph and the Southern Birdwing, do not have any mimics. The Tawny Coster is the sole representative in peninsular India of an African group, where its kin have numerous mimics. The Birdwing and the Tree Nymph have no mimics probably because they are too large in size compared to other butterflies.

Among the Indian butterflies, the Tigers and the Crows together form the maximum number of models and Müllerian mimics. The family Nymphalidae has the highest number of Batesian mimics. The family Pieridae has only a few models and mimics. Mimicry is absent in the families Lycaenidae and Hesperiidae, which are phylogenetically distant to the three families in which it is observed, namely, Papilionidae, Pieridae and Nymphalidae.

Suggestions for student projects Limited information is available on mimicry among peninsular Indian butterflies. Secondly, this region is richer in model and mimic butterflies as compared to larger areas on other continents, such as North America and Europe. We also have very interesting species, for example, the Common Mormon and Roses, which together form a good system to study mimicry.

The following observations related to various aspects of mimicry can yield useful results and may easily be carried out by students:

1. The average ratio of males to females in mimetic species, for example the Common Mormon and the Danaid Eggfly—this can be done by noting the number of males emerging from the pupae as compared to the number of females.
2. As mentioned above, the mimics should be in a lesser proportion as compared to the models. To calculate the relative proportions of the models and the mimics in an area, they may be censused for their abundance in their habitats.
3. The relative abundance of the sexes or forms may change regionally, especially when the mimetic species is widespread and if its specific forms mimic different models, as mentioned for the Common

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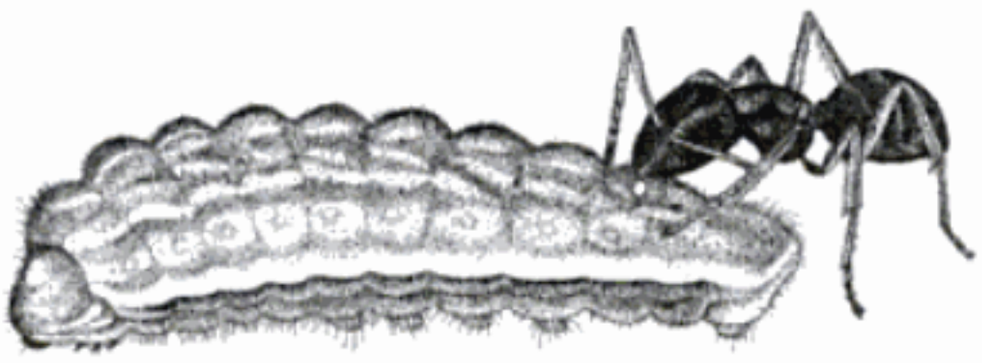
Mormon. It would be helpful to compare the relative abundance of the sexes and the three female forms of the Common Mormon in different localities in peninsular India, to see how and why the abundance changes.

4. Since many butterfly species occur seasonally, it would be important to census the mimics and models seasonally. The flight periods of good mimics are expected to match those of their models. These patterns may be explored by seasonally sampling the butterflies in an area.
5. A good mimic would also have achieved synchronization with its model in behaviour, such as the daily activity patterns and habitat use. Convincing mimics, for example, the Danaid Eggfly and Common Wanderer, may be compared for these behaviours with their models and with relatively less perfect mimics, for example, the Great Eggfly, relative to their models.

iv) Association with Ants Many Blues are either camouflaged or at least dull on their undersides. Some of them (for example the Red Pierrot) are possibly unpalatable. However, camouflage and unpalatability are not really the main survival strategies of Blues. One of their effective strategies is prominent tails and metallic spots on the underside of the hind wings, which deflect the predators' attention to non-vital parts (this is discussed in family account of Lycaenidae). This is how adults of many Blues are protected, but their vulnerable caterpillars are protected through a remarkable symbiotic association with ants. Ants usually eat caterpillars of butterflies if they find any, but with Blues, they have a different deal. Most Blues caterpillars have glands on the 11th and 12th segments, which secrete a sugary solution: the "honeydew". The ants harvest the honeydew from the caterpillars and, in return, protect them from parasitoids and small insect predators (Plate 3, no. 13). For this purpose, they constantly surround the caterpillars and are



An ant tending to a Blues caterpillar

so possessive of them that no harmful animal is allowed close to the caterpillars. And if the ants want the honeydew when the caterpillars are not prepared to secrete it, then the ants coax them to do so by gently stroking the caterpillars' glands with their antennae and jaws. The result is, throughout their lives the caterpillars have to produce a considerable amount of honeydew as 'protection fee' to the ants.

The association of Blues caterpillars with ants is an astonishing case of co-evolution. The butterfly females lay eggs wherever ants are present, making some compromises regarding the species of host plant or the place of egg deposition. In certain groups of Blues, the caterpillars and the ants are even known to communicate with each other through substrate-borne knocking sounds. Therefore the presence of ants on suitable phenophases of the plants seems to be a more decisive factor while choosing the host plant, rather than the species of the plant. Due to this reason, some Blues caterpillars feed on a large number of unrelated plants of different families. This may decrease their metabolic efficiency, as they have to deal with a wide variety of chemical compounds. However, the butterflies have evolved to bear this cost because the benefits from this association are greater. The caterpillars may have reduced digestive efficiency and have to secrete the metabolically, costly honeydew, but they are much safer when they are under the guard of the protective ants. In fact, the caterpillars which are protected against predators and parasitoids by ants may be 30% to over 60% more likely to succeed in pupation than the ones which are not protected by ants.

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Suggestions for student projects Blues are present sometimes even in the backyards of urban dwellings. Therefore, they are as easy to study as they are interesting. Their caterpillars can be reared both under controlled conditions and in the wild. The survival and growth rates of the ant-tended caterpillars (for example the Lime Blue, Silverlines and Oakblues) can be studied under: 1) parasitoid-free controlled condition, 2) uncontrolled conditions in the absence of ants, and 3) uncontrolled condition in the presence of ants. This will give us an idea about the relative importance of the protection given to the caterpillars by the ants. As an additional comparison, the results of these experiments can be compared with those on the following species: the Gram Blue, Pea Blue and Common Pierrot as occasionally attended species and Zebra Blue and Tiny Grass Blue as the species that are not attended. These can also be compared with the survival and growth rates of butterflies from other families, so that relative survival rates and the impact of parasitoid infections can be studied for a diverse group of butterflies.

3. Conservation Problems and Solutions

Butterflies are not tasty and usually not nasty (except those that damage crop or garden plants), so they are not hunted by humans. But certain beautiful butterflies are collected in large numbers for ornamental purposes. In India, however, such grave attempts that challenge the very existence of a butterfly species, are probably rare. The only places in India where considerable butterfly trading goes on are in the Himalayas and in northeastern India, from where large and very attractive Swallowtails and other butterflies are caught and illegally exported. If it is not illegal collecting or hunting, what exactly endangers the butterflies? As of now, it appears that the main threats to butterfly diversity or survival of vulnerable species are: i) habitat destruction, degradation and fragmentation, ii) grazing, iii) fires, and iv) application of pesticides and weedicides in agricultural and urban ecosystems. If other factors are favourable, air pollution alone does not appear to affect the survival of butterflies. Thus, the Tailed Jay and Indian Palm Bob abound in tiny gardens in Mumbai's ecologically worst industrial areas and the Giant Redeye and Common Palmfly produce generations of offspring on ornamental palms beside clogged roads in Bangalore city. However, pollution only follows industrialization and urbanization, which affect most butterflies by destroying their habitats, nectar plants and more importantly, their larval host plants.

Causes that Endanger Butterflies:

i) Habitat Destruction, Degradation and Fragmentation Destruction, degradation or fragmentation of habitats are the most worrying causes of butterfly species extinction, or their retreat into smaller pockets that are ultimately prone to extinction. These causes always work in tandem and are also creators and facilitators of the other causes that endanger butterflies. In peninsular India, habitat loss or degradation and subsequent fragmentation take place and have taken place due to river valley projects, expansion of agricultural land, and extensive monoculture tree- or tea-plantations.

River valley projects have drowned some of our most beautiful and contiguous riparian and evergreen forests. They still continue to do so. The worst-hit area is one of the world's biodiversity hotspots, the species-rich, biogeographically important Western Ghats. The projects have reduced habitat cover of butterflies mainly from deciduous

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and evergreen forests, which are the habitats that harbour the maximum diversity. Since most butterflies here are more or less dependent on the riparian forests, the loss of riparian habitats means a great loss of habitat to butterflies, along with other animals and plants. A special problem is caused by the fluctuating shore-lines of backwaters of the dams. The fluctuating and exposed land–water boundary spoils the mud-puddling spots of the butterflies, thus affecting them badly because their fecundity is influenced by mud-puddling. So, although the dams may increase the extent of water and wet soil, the butterflies cannot use this.

Habitat degradation and fragmentation due to the expansion of agricultural lands have been rampant throughout India. Better use of the available land and environment-friendly agricultural practices will perhaps reduce the magnitude of this problem. However, the extension of agricultural lands also leads to more intense grazing and fires, and deeper and more extensive penetration of pesticides into natural ecosystems.

In the Western Ghats, tracts of rubber, teak and other tree plantations (monoculture) occupy enormous areas which were earlier natural forests. What is worse, many 'sal' (*Shorea robusta*) forests of central India and evergreen and semi-evergreen forests of the Western Ghats have been converted to teak plantations. However, the teak plantations are better habitats for butterflies than rubber plantations which have recently been expanding rapidly. Added to tree plantations, tea and coffee plantations of the Nilgiris, Anamalais and other higher mid-elevation localities have devastated and the dense evergreen forests of the Western Ghats. However, tree plantations support at least a few butterfly species, albeit commoner and more widespread ones, whereas tea plantations support not a single butterfly in its larval or adult stage.

ii) Grazing Grazing adversely affects butterflies in two major ways: i) trampling, and ii) effects on vegetation composition. Due to trampling, the early life stages of butterflies get killed, and in severely grazed areas this loss of numbers may be considerable. However, trampling would affect more or less all butterflies that feed as caterpillars on herbs and grasses. The effects of actual grazing, on the other hand, bring about changes in a habitat that may completely alter the vegetation composition and suitability of the habitat to certain butterflies. Due to intense grazing, the palatable herbs and grasses are replaced by unpalatable ones that harbour more browsing deterrents. Therefore, grazing favours butterflies that feed on unpalatable herbs in their larval stages, and replaces or reduces in numbers those butterflies that feed on palatable herbs and grasses. Thus, grazing may reduce the population of the Gram Blue and Plains Cupid, and boost that of the Joker (*Byblia ilithyia* Drury). The former feed on palatable herbs (species of gram, beans and other small herbs), whereas the latter feeds upon stinging nettle (*Tragia* spp.), which the grazing animals shun.

The unpalatable or stinging herbs and grasses probably evolved in naturally disturbed habitats. Therefore, the butterflies feeding on these plants are also inhabitants of disturbed areas. Trampling and intensive grazing by livestock create situations favourable to these plants and butterflies. This has assured extensive areas covered by the habitat of butterflies that feed on the unpalatable plants. Their future seems more secure than those species that cannot survive in heavily grazed areas. Unfortunately, the species feeding on palatable plants outnumber those feeding on unpalatable ones, so grazing has a negative impact on butterflies.

In forested areas, grazing affects regeneration of large woody plants. Since most butterflies in these habitats feed on woody plants in their larval stages, their resources are soon depleted. However, in the deciduous forests which get burnt every year, grazing may not affect butterflies as badly as do fires.

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Although both fires and grazing are disturbances to butterfly and other insect life, grazing is in many ways more tolerable than fires because it does not bring about total destruction. It also does not disturb the flight periods of butterflies, as do fires. It may replace palatable herbs by unpalatable ones, but the herbs still support many more butterfly species than the bunch-grasses that grow after the invasion of fires.

iii) Fires Fire is a very strong destructive agent, and its effects on vegetation (and ultimately on butterflies that depend on specific plant species) are very pronounced in a short time. In open habitats such as grasslands, scrub and dry deciduous forests, fires destroy annual grasses and herbs and these are replaced by tall grasses that have very large root-stocks. These grasses are called "bunch-grasses". These have evolved to cope with very dry and hot conditions which are found on rocky slopes or created after fires. Therefore repeated fires means dominance of bunch-grasses, which, due to their silicaceous leaves, are avoided by grazing mammals and many insects, butterflies being among them. Some butterflies such as Evening Browns and Rings do feed on bunch-grasses in their larval stages. However, they prefer annual grasses that are usually more palatable and nourishing during most of their growing or reproductive stages.

Fires desiccate the evergreen forests, and increase the proportion of deciduous trees in them. At the ground level, they disturb the microclimate of the herbs growing on the forest floor, and finally make it suitable only for weedy plants. Thus, nectar plants, or more importantly, larval host plants of the butterflies are destroyed. In the process, fires cause deterioration of the habitat of many butterflies. In both these cases, fires promote the growth of only certain plants at the expense of the majority of the other plants. Unfortunately, the plants that are encouraged by fires are the ones that are not as useful to native animals as the plants that are destroyed.

The above effects of fire on butterflies operate indirectly through changes in the vegetation. The fires also directly affect butterflies by effectively destroying the immobile early stages or certain less mobile adult butterflies, such as the Grass Blues and Grass Yellows. The most serious direct impact of fires on butterflies is the loss of flight periods. In and around Pune city, the Common Three-ring, Lemon Pansy, Chocolate Pansy and Lesser Grass Blue are found commonly in both fire-free as well as fire-afflicted areas. However, in areas where fires recur every year, these butterflies are abundant only during the post-monsoon season, their flight period in the summer months is lost to fires. Butterflies that spend most of the post-monsoon and summer months in dormant stages are also affected by fires because their dormant stages are killed in the fires. The Grass Demon is probably one such species affected by fires in its dormant stages. In fire-afflicted areas, this species survives due to a few individuals that are spared by fires in riparian areas that cannot be accessed by the fires. Given all these adverse effects of fire on majority of biodiversity (especially plants, butterflies and other insects), it is worrisome to see that sometimes wildlife managers advocate fires as management tools. Some State Forest Departments have also officially adopted fires as tools for managing only ungulate (hoofed) and carnivorous mammals. This is at the expense of all the other animal and plant groups in the last remnants of the rich tropical forests, grasslands and other natural habitats.

iv) Application of Pesticides and Weedicides This is a secondary problem caused by habitat reduction and fragmentation due to agriculture. It juxtaposes agricultural lands or tea- and coffee-estates with forests or other butterfly habitats. In the estates and agricultural fields, usually very toxic pesticides and weedicides are used. Since the chemicals do not discriminate between useful, harmless and harmful creatures, they kill all the life forms growing wherever they are sprayed. The weedicides remove larval host plants of butterflies, and pesticides destroy the early

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stages. This is also a serious problem in urban ecosystems situated far from the forests.

Suggestions for student projects Various aspects of the biology of animals and plants relating to their conservation are being now studied under a scientific discipline known as "Conservation Biology". In many regions, research in the area of conservation biology has become the main guideline for the management of natural and human-impacted habitats and landscapes. In India, a land where environmental and ecological problems are both omnipresent and omnipotent in species-rich habitats, studies in conservation biology are urgently needed. Simple studies can elucidate crucial impacts of the disturbances that cause the conservation problems, and solutions to them. The questions that can be addressed may be on the following lines.

Effects of fire and grazing: Are there more butterflies (in terms of number of species as well as number of individuals) in fire-free and less grazed or ungrazed areas, as compared to fire-afflicted and heavily grazed areas? What changes take place in the species composition of plant communities in these areas? How is the abundance and growth of host plants of butterflies affected by fires and grazing? Does this result in elimination or reduction in the abundance of certain butterfly species from an area? Are the butterflies that invade affected habitats more widespread? To find the answers to these questions, butterfly counts will be needed in the less grazed and heavily grazed areas, and fire-free and fire-afflicted areas, before and after the grazing or annual fires take place. Compare the results of these studies with those in the undisturbed or less disturbed areas, preferably situated in similar neighbourhoods.

- **Measures to Conserve Butterflies**

i) Legal Measures Legal protection is granted at various levels to animals (including butterflies), plants and their habitats. The Wildlife (Protection) Act, 1972 ('WPA', amended 1993) lists the butterfly species that are a priority for conservation. Under the WPA, the collection of the listed butterflies from the wild, or any action leading to threatening their habitats, is prohibited.

The WPA has six schedules, each listing various species. The legal protection afforded to the species is the highest if it is listed in Schedule I. The protection is second best if the species is listed in Schedule II, and so on. Any offense against the species in Schedule I makes a person liable to imprisonment up to 6 years and a fine. The other Schedules have less severe punishment for the offense. Animals from schedule V are declared vermin, but no butterflies are listed under it. In all, the WPA has listed 450 butterfly species and subspecies in its Schedule lists: 128 under the first Schedule, 303 under the second and 19 under the fourth. Other Schedules do not have any butterflies listed under them.

The first Schedule lists 15 butterfly species that are found in peninsular India. However, of these 15, the ten listed are subspecies occurring outside peninsular Indian limit. The five that are found in this region are: 1. Blue Nawab (*Eriboea schreiberi* Godart), 2. Blue Baron (*Euthalia telchinia* Ménétriés), 3. Danaid Eggfly, 4. Malabar Banded Swallowtail, and 5. Crimson Rose.

The second Schedule lists 47 peninsular Indian butterfly species and subspecies. Of these, 9 subspecies listed are not found in peninsular India although the species are found there. Among the 38 species and subspecies that inhabit this region, the following are mentioned in this book: 1. Southern Duffer, 2. Common Beak, 3. Small Leopard, 4. Redspot Duke, 5. Common Baron, 6. Grey Count, 7. Danaid Eggfly (repeated in this schedule!), 8. Southern Blue Oakleaf, 9. Great Evening Brown, 10. Whitebar Bushbrown, 11. Tamil Oakblue, 12. Pea Blue, 13. Indigo Flash, 14. Scarce Shot Silverline, 15. Longbanded Silverline, 16. Peacock Royal, 17. Many-tailed Oakblue, 18. Malabar Banded Peacock, 19. Common Albatross, 20. Chocolate Albatross, 21. Lesser Albatross, 22. Lesser Gull, and 23. Common Wanderer.

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The fourth Schedule lists the following peninsular Indian butterfly species or their subspecies that are mentioned in this book: 1. Brown King Crow, 2. Gaudy Baron, 3. Plain Banded Awl, 4. Tamil Dartlet, 5. Dark Pierrot, 6. Striped Albatross, and 7. Painted Sawtooth.

The WPA was the first, modern legal step at the national level towards the conservation of all wildlife in India. It was naturally welcomed by all, and its subsequent amendments have certainly increased its usefulness. However, the butterfly lists in the Schedules of the WPA are very biased and inadequate. For example, Brush-footed butterflies make up the lion's share among the listed species (211 species), whereas Skippers are very poorly represented (12 species). Apart from this bias towards certain butterfly groups, the butterflies have also not been chosen based on extent of their geographical distribution and abundance. For example, the Pea Blue and the Danaid Eggfly are widespread and common species, occurring in many habitats. But they are protected under Ist and IInd Schedules. The former is also a minor pest on cultivated varieties of peas and beans! Similarly, the Common Wanderer and the Common Baron are common species that often do well in wooded urban gardens, but are still placed in the IInd Schedule. On the other hand, many of the Western Ghats endemic butterflies, for example, the Tamil Yeoman and Golden Flitter, are not mentioned in the lists. Particularly, some species (for example, the Golden Flitter) are not only endemic to a narrow portion of the Western Ghats, they are found only in evergreen forests. Therefore, they need to be given higher protection and priority in the WPA. For these reasons, an objective revision of the Schedule lists will be very useful in providing appropriate and adequate legal protection to Indian butterflies.

ii) Forest Departments Presently, there are no special policies to conserve insects in the wildlife sanctuaries and national parks of India. However, the control of fires and grazing in the protected areas may be the best step the forest departments can take to enhance or maintain the diversity of insects (and also overall diversity) in their natural landscapes. There is now a need to rethink about fire management beyond conservation of merely ungulates, pachyderms and large carnivores. This rethinking should also focus on smaller organisms which, in fact, often play more important, but largely unappreciated, roles in nature.

iii) Integrated Management There are several butterfly parks, butterfly breeding centres, and butterfly breeding and research stations in many parts of the world. Some of them have employed local people, often tribals, for the task of rearing butterflies from caterpillars. The host plants of butterflies are given protection in their native habitats, and caterpillars are reared on them. The reared butterflies are used either in butterfly parks or to prepare popular butterfly articles such as wall-hangings, key-chains and gift articles, which fetch a good price and make this exercise financially self-sustained. If this method of breeding butterflies in their native habitats is widely used, it can potentially protect butterfly habitats, target species as well as other butterfly species, and involve the local people in the conservation of forests and wildlife without displacing them. This has not been attempted in many subtropical and tropical countries, including India. However, this could potentially prove to be one of the measures to conserve local human communities, wildlife and habitats, in areas not yet declared as protected areas by governments.

iv) Ordinary Citizens Often the ordinary citizens may not directly be able to help conserve butterflies and their natural habitats. However, larval host and adult nectar plants (brief information an these plants is given in Appendix 2) grown in urban gardens attract more than a dozen butterfly species. Instead of landscaping each and every inch of urban area, if small patches are allowed to overgrow as 'wild patches' in college and university campuses, large gardens and parks, riversides,

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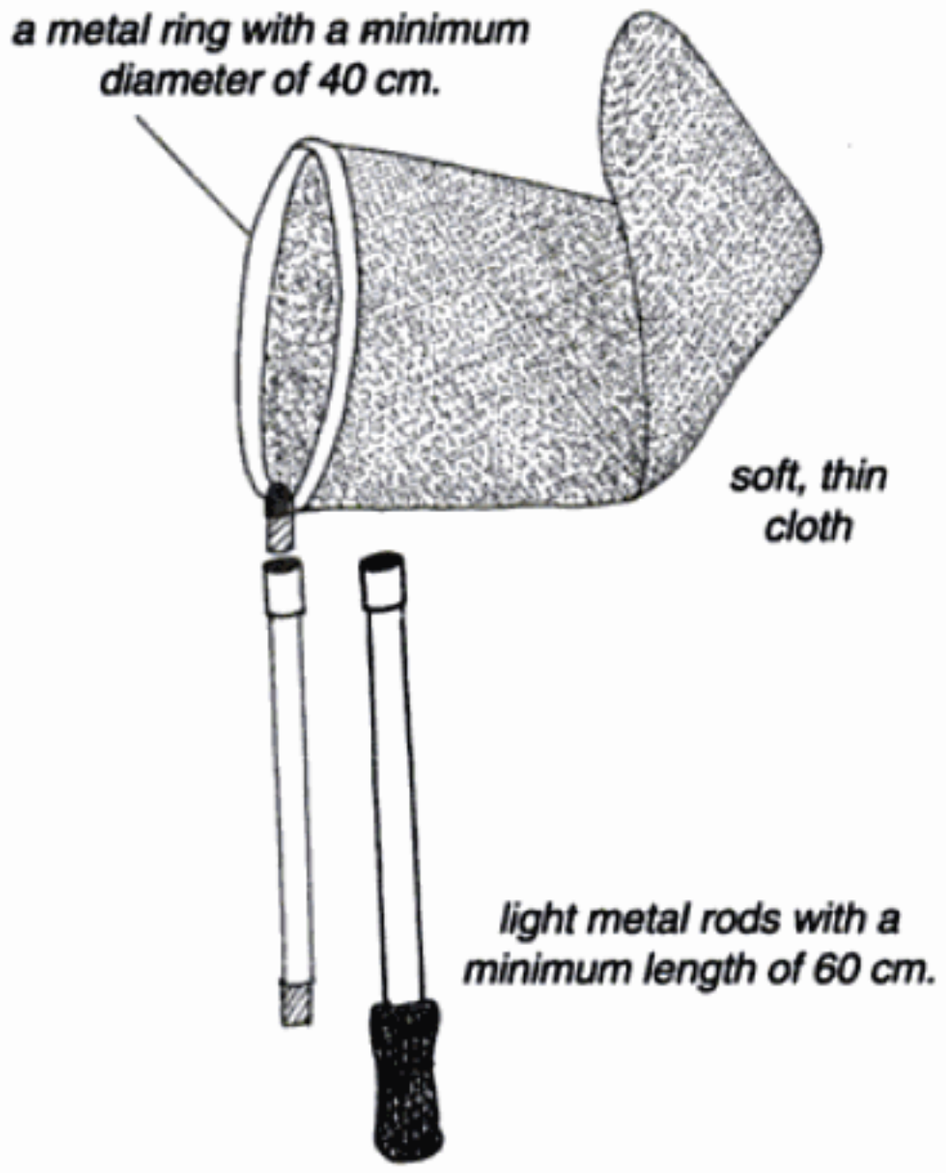
etc., then another couple of dozen butterfly species will find a home in urban or otherwise inhabited areas. Although this will be an alternative home in an altered landscape, it is still some compensation to at least some of the original butterflies in one's own area. Thus, growing a few plants that support butterflies and leaving a 'wild' place for them around habitations are two simple but very effective steps every person can take towards conserving butterflies. The use of small quantities of pesticides, or none at all, in gardens is another step that will help many butterflies.

4. Collecting and Preserving Specimens

Many butterflies can be readily identified and a few aspects of their biology studied in the field. However, once in a while one sees this obscure little Skipper here and that Albatross there. Most field workers would opt out of species identification of butterflies from these slightly difficult to distinguish groups, but those oriented towards serious study of butterflies or ecology may find it necessary to collect them. Also, certain characters can be checked only in preserved specimens, and therefore maintaining a systematic collection of butterflies is useful. Some butterflies, due to their rarity or some other considerations, are protected by law, and there is a restriction on collecting all butterflies from wild. Therefore, it is necessary to obtain permission from the State Forest Departments before going out into the field to collect butterflies. Once permission is obtained, the specimens can be collected and preserved, using the methods that are described below.



Butterfly Net

Butterfly net and the method of catching butterflies An essential tool to catch butterflies is a long-handled butterfly net. The simplest butterfly net can be prepared using a light metal rod or pipe, a light metal ring and piece of soft, thin cotton mosquito net. Although the long handle of the net helps in catching butterflies resting a few feet away, some butterflies are very wary, and keep a safe distance from the observer. If they are resting on the ground, the best way to approach them is to kneel and move towards them as slowly as possible. Before getting down on one's knees, it is useful to hold the net in front and slightly raised. Once the butterfly is in sweeping range of the net, the net should be rapidly brought down on the butterfly. Butterflies usually tend to fly upwards when caught in the net, and when they get close to sealed end of the net, the rim should be rapidly turned around to close the net. Then the net can be lifted without letting the butterfly escape. If the butterfly is resting on vegetation, the net can either be brought down upon it or swept in from the side. Whichever method is used to catch butterflies, the key factors leading to

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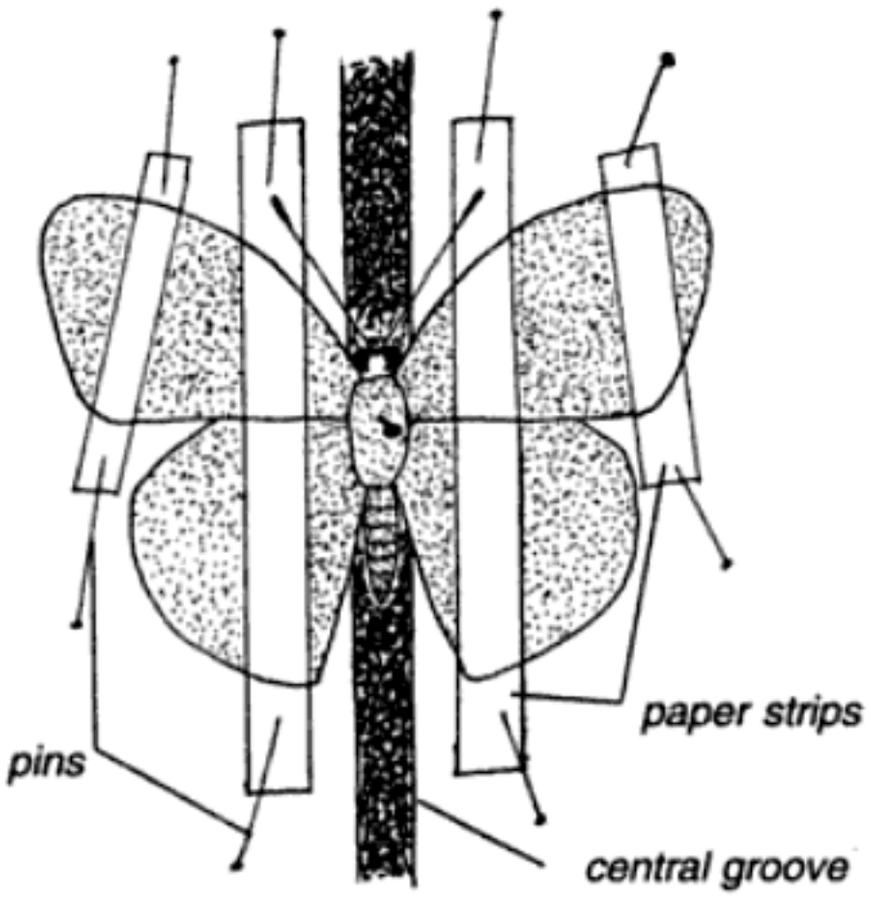
success are stealth when approaching the butterflies, and speed when sweeping the net.

Once the butterflies are in the net and the net has collapzed on them, they should be either immediately immobilized or transferred to a sufficiently large container. Otherwise they flutter and try to escape, in the process damaging their wings. They can be immobilized or even killed by lightly pinching their thorax. Butterflies for which this otherwise effective and universally used method does not work are the Tigers, Crows, Tawny Coster, and Awls and other powerful Skippers. For these as well as all other butterflies, killing jars are more convenient. Killing jars are containers containing cotton swabs with harmful chemicals (such as cyanide, diethyl ether, ethyl acetate and chloroform), the fumes of which kill the butterflies.

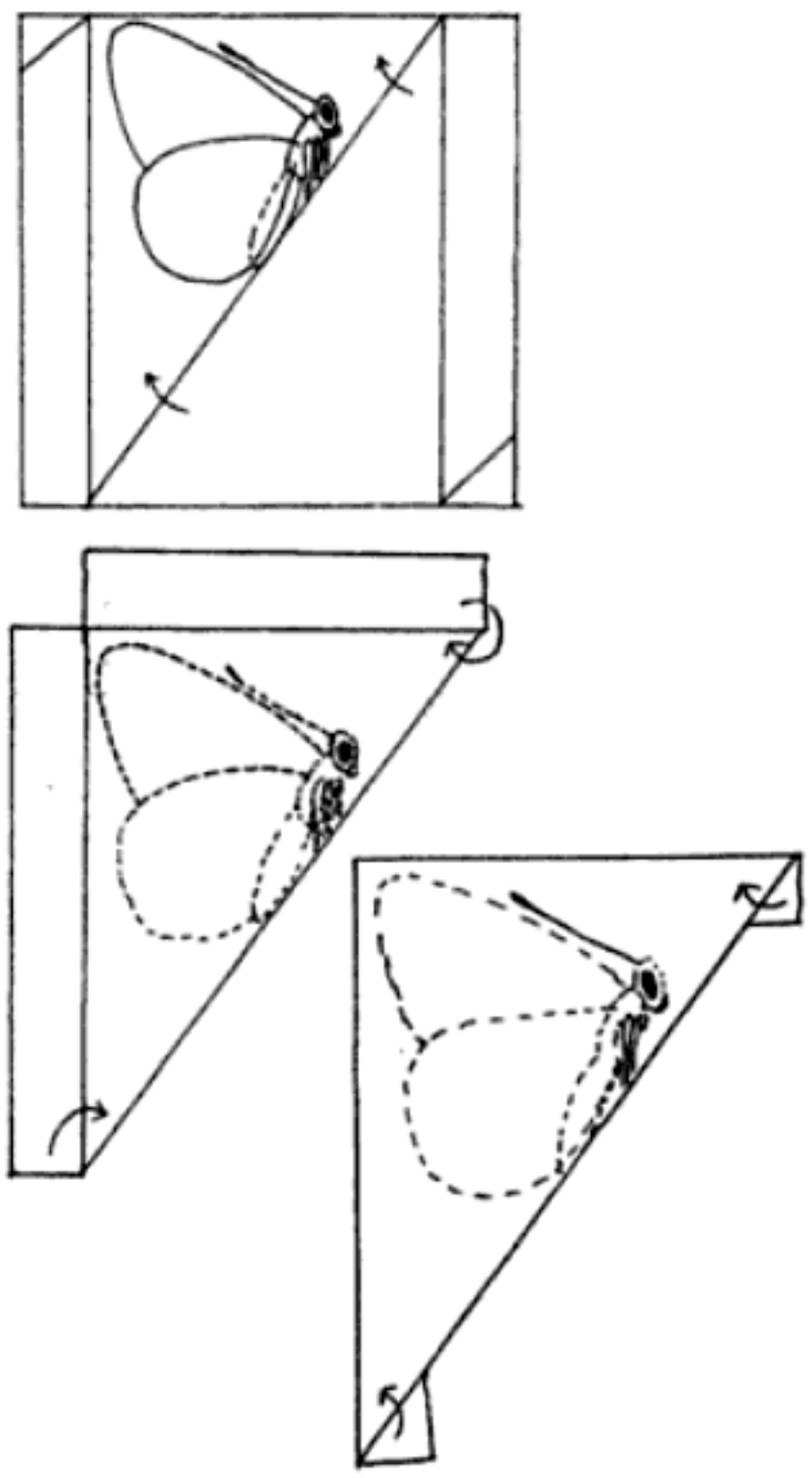
Spreading boards After the butterflies are killed, they need to be pinned and spread before their muscles become rigid. Since the butterflies are small and not fleshy, they can be dry-preserved. For this purpose, a spreading board is needed. A spreading board has a groove in the middle with two flat surfaces on either side of it. An adjustable spreading board whose groove width can be changed, is more convenient. The body of the butterfly should fit into the groove, and the wings should be spread on the flat surfaces. Strips of butter-paper can be used to hold the wings in the right positions and then they can be set with pins. A long, rust-proof pin goes through the middle of the thorax of the butterfly, and then using either a longer pin or a needle, the wings can be spread. The outspread wings should be immediately fixed with butter-paper. The lower margin of the fore wing should be at a right angle to the body, and the antennae should be in front of the head.

Paper envelopes and storing specimens If the specimens cannot be spread immediately, they can be stored in butter-paper envelopes. The antennae of the specimen should be kept along the leading margin of the fore wing, so that they do not break after drying. The paper is folded in a triangle such that it secures the specimen inside from all three sides (see the illustrations). The paper triangle should be just large enough to accommodate the butterfly.

When the body of the dead butterfly becomes dry and rigid, the butterfly cannot



Butterfly on a Spreading Board



Butter-paper Envelopes to Store Butterflies

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be spread. However, if the dry butterfly is kept in a container with a little water and ethyl acetate, its muscles relax and then it can be spread in the conventional manner. Whether the specimen is spread immediately after killing or after it dries up and is made to relax, it should be left to dry for at least two days, after which the pins and paper strips can be removed and the specimen pinned in a wooden box.

The wooden boxes should be without slits and holes, that is, completely closed from all sides and covered from the top, preferably by glass. The boxes should be equipped with small cotton swabs moistened with insect repellent chemicals (for example, naphthalene and creosote oil), so that other insects that may destroy preserved specimens are kept away from specimen boxes.

The unorthodox method of preserving butterflies in transparency sheets cannot be used for systematic collections, but is very useful for maintaining personal reference collections. In this method, the wings of the butterflies are removed from the bodies. A little fevicol or similar transparent adhesive is applied to bases of the wings, and they are then stuck on to transparency sheets that are used for presentations. After the wings are properly set on the sheet, another sheet is placed on top of it, and the two sheets are then sealed together along the sides with a cellophane tape. The sheets can then be arranged in a file or folder, and transported with ease. They also occupy very little space.

The best way to get undamaged and fresh adult butterfly specimens is to rear them from caterpillars. Although it may be difficult to find caterpillars unless one is familiar with the habits of butterflies as well as plants on which their caterpillars feed, it is not very difficult to rear butterflies at home. The caterpillars need only fresh food and clean containers, and no more care. Therefore, if foliage in the containers is changed every alternate day and the containers cleaned once or twice a day (depending on how fast the caterpillars dirty them), the caterpillars remain healthy and grow rapidly. After the butterflies emerge, they should be kept alive for at least a day, when their wings become rigid enough for spreading. During this period they should be kept in darkness so they do not flutter and damage their wings or lose scales. The advantage of rearing caterpillars is also that early stages of the butterflies can be photographed and notes on their habits maintained. For our butterflies it is particularly very important, because the early stages of less than 30% of Indian butterflies are reported, and only about 10% are photographed. Here is an area to which plenty of amateurs and naturalists can contribute.

If eggs, caterpillars and pupae need to be preserved, they can be stored in 70% alcohol. In alcohol the specimens slowly lose their colours, so it is better to photograph the stages before preservation. Thus, for the early stages, the colours can be captured on film while details of morphology and anatomy can be studied from the specimens in alcohol.

Regardless of how the various stages in a butterfly's life are preserved, the following information should be recorded in the field notebook: the name of species, exact locality (with the nearest landmark, taluk or district and state), habitat and altitude where the specimen was collected, date and time of the day, and notes on behaviour of the specimen when it was seen. Since the preserved specimens in museums have small labels, only the following information can be written on the labels: species name, date and place of collection, and name of the collector.

It is always better to observe the butterfly for some time in the field, before catching it. In case the species turns out to be a very interesting one, notes on its behaviour could be useful as new information about the species. This information could also help in future field identification, so more individuals of the species can be spared from being collected.

Greater details on collecting and preserving butterflies can be found in Oldroyd's book (1970) or similar books on this subject.

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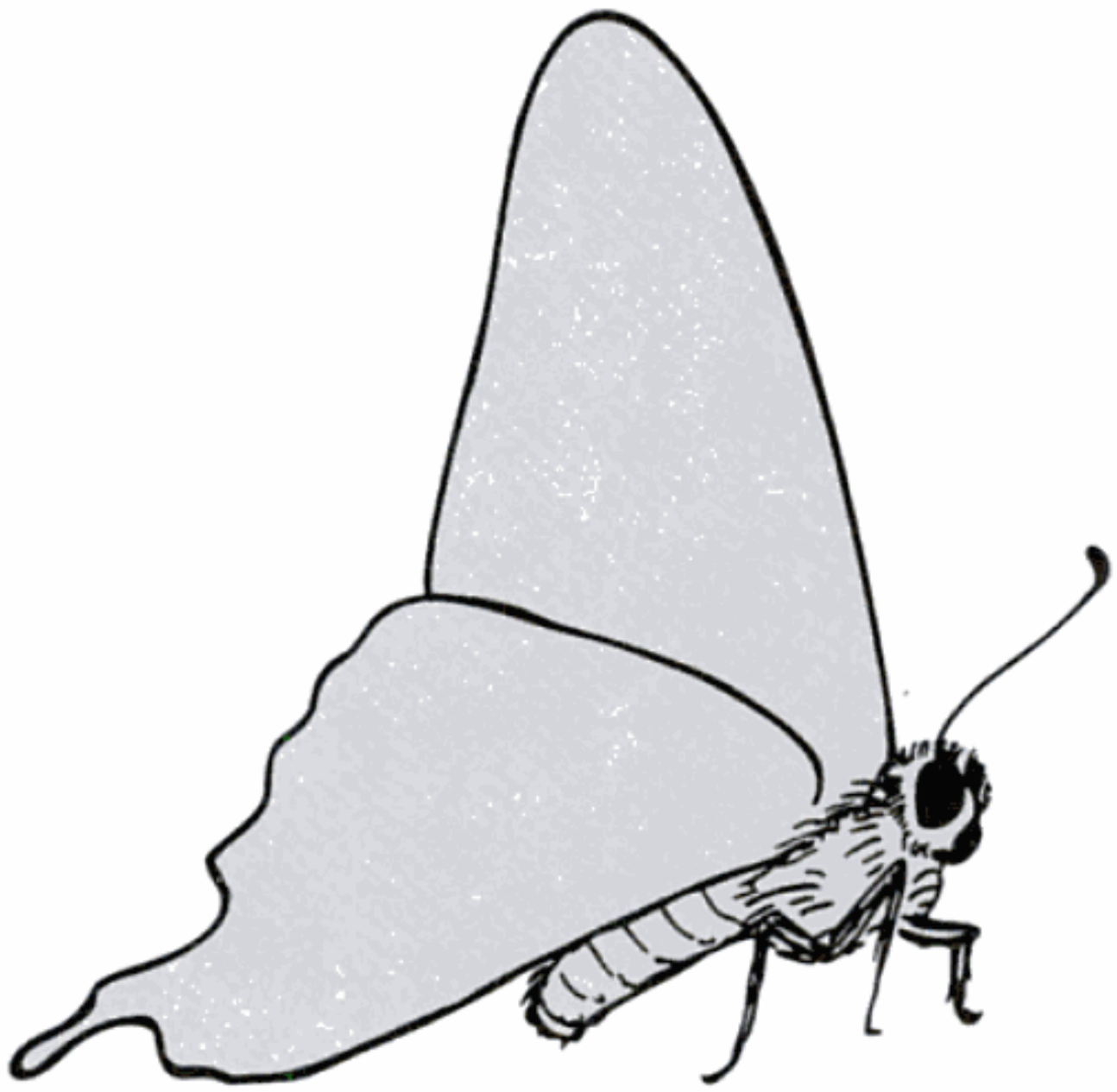
5

Butterfly Family and Species Accounts



5.1 Family Papilionidae

Swallowtails

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Family Papilionidae

Sporting small tail-like extensions to their hind wings, Swallowtails, as members of this family are popularly known, are among the best-known of the butterflies. This family includes the largest, the most attractive and the most endangered of the butterfly species. The Birdwings, which the tribal folks shot with bows and arrows, and armed hunters with air rifles, are the world's largest butterflies and belong to this family. The Blue Peacocks and Banded Peacocks are among the most brilliant of the larger butterflies. The Appollo butterflies (*Parnassius* spp.) fly in the temperate areas, sometimes in cold seasons and at very high altitudes in the Himalayas, when hardly any other butterflies are active. The name of the superfamily Papilionoidea to which all 'true' butterflies belong, is derived from the Latin 'papilio' for butterfly. This has also bestowed its name upon this butterfly family, making Swallowtails an icon of the butterflies.

This is the smallest butterfly family in the world, with merely 700 species (4% of global butterfly diversity), but has a worldwide distribution. Its members occur on all the major continents and at higher latitudes, but their diversity is at its peak in the tropical areas. They also fly at sea level (Malabar Banded Peacock, Malabar Banded Swallowtail) and above 5, 000 m. (Apollo butterflies), near the ground (Common Mormon and Blue Mormon), and in the canopy of the tallest forests (Tailed Jay), in arid scrub (Lime Butterfly), and in tropical evergreen forests (Paris Peacock, Malabar Raven, Common Bluebottle). Thus, they are omnipresent and, due to their large sizes and striking colours, also very prominent. India harbours 107 species with peninsular India accounting for 19 species. The remainder of the Indian species occur in the western and eastern Himalayas and northeastern India.

Members of this family have similar general body forms, in spite of dissimilar habits and habitats. Their legs are long and slender, obvious when the butterflies delicately balance themselves on them while nervously mud-puddling or feeding from flowers. The head is round, narrower than the shoulders and their eyes are black. The labial palpi are small, therefore the coiled proboscis, which is long, is easily visible. The thorax is large and long, but the abdomen is even longer. The body is often marked with thin longitudinal lines, which are of a contrasting colour to the body. The fore wings are long and narrow or broad, but the hind wings are almost invariably broad.

The two sexes have similar markings with some subtle differences. The males may have fluffy scent scales in a fold on the hind wing (Plate 1, no. 4). The females are usually larger.

All species are avid nectar-feeders. The Mormons and Peacocks frequent to wet soil but not in great numbers. The Common Jay and Lime Butterfly, however, can sometimes form large mud-puddling congregations of several dozens. The Blue Mormon is also fond of mammalian droppings, especially bovine dung. These butterflies are usually very restless and flutter even while feeding.

A few species, for example, the Red Helen, Paris Peacock, Common Mormon and Lime Butterfly, regularly bask with their wings spread flat. The fore wings are lowered to partly cover the hind wings that have bright markings. The Jays and Bluebottles rarely bask and when they do, only for a very short while and high up in the trees.

They are generally non-migrant species. However, two exceptions, the Lime Butterfly and Crimson Rose, can occasionally form very large migratory swarms and travel long distances.

Some are economically very significant species. The Lime Butterfly is a pest on lime, lemon, orange and other cultivated *Citrus* plants. It can occasionally turn into a serious pest, causing considerable damage to the plants. Others, for example, the Birdwings

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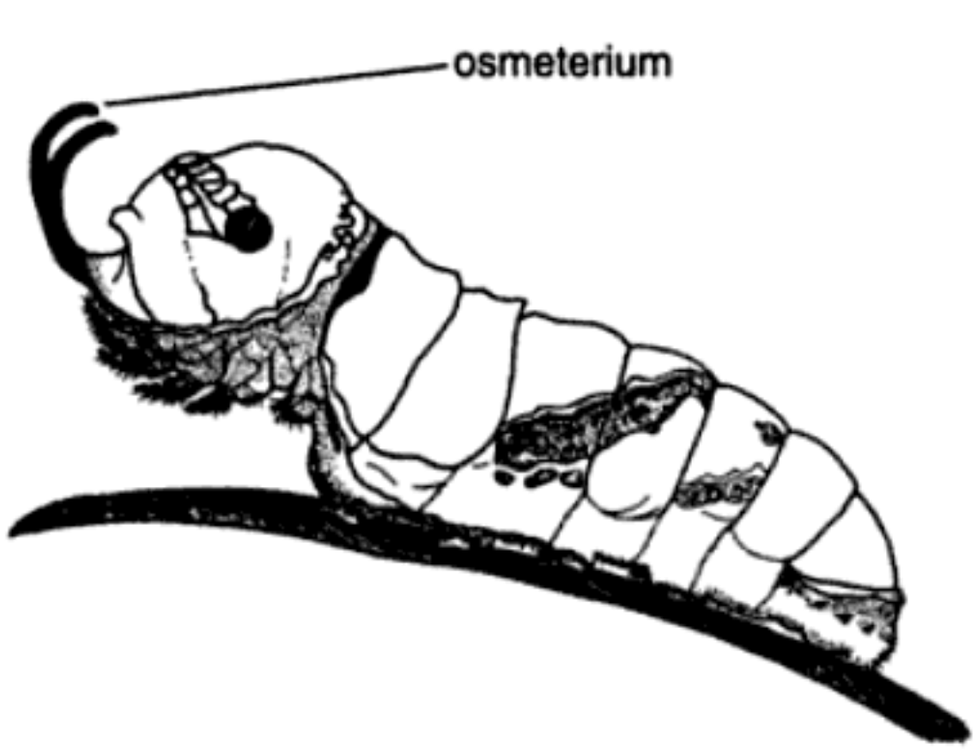
and the Peacocks, are valuable in trade as high-priced fancy items (this is legally banned in India).

The eggs are round, usually yellow-white or greenish in colour, occasionally blotched with rufous or maroon-red. They may be minutely pitted, but usually without any fine ornamentation. They are laid singly (except in the case of the Malabar Banded Swallowtail, which lays them in groups of half a dozen or more) on the uppersides or undersides of fresh leaves. The caterpillars are sluggish and, if disturbed, move reluctantly. The form and markings of the full-grown caterpillars are different in different groups (see below). Except in the Birdwings and Roses, all the caterpillars resemble birds' droppings until they are through the third instar. They are mossy-green or brown and glistening, as if wet, as well as blotched and streaked with darker markings. They also have a white patch on the back, which is similar to the patch of uric acid seen in the bird-droppings (Plate 3, no. 14). This mimicry is marvelous in Mormons, the Malabar Raven and Lime Butterfly, not so good in the Common Jay and Tailed Jay. After the third instar the caterpillars remain a uniform bright green with a few markings apart from the thoracic bands.

All the caterpillars have a terminally bifid, fleshy, translucent gland, called "osmeterium", between the head and the first thoracic segment. The osmeterium is retracted inside, but the caterpillars exsert it when they are alarmed



Common Mormon Caterpillar with Osmeterium Exserted

(Plate 3, no. 15). The gland gives out a strong repulsive odour derived from the essential oils or aristolochic acids in the host plants, thus warding off certain parasitoids and predators. Nonetheless, all the species are heavily parasitized by parasitoid wasps, which emerge from the pupae after eating the contents.

The pupae are thick and bent at the back, always supported by the body-band. They have projections on the head and the thorax, the placement and shape of which are specific to each group (see below). They can jerkily move from side to side and produce a faint sound if touched.

Swallowtails are classified into only three subfamilies: the Baroniinae with a single species endemic to Mexico, the Parnassinae (Apollo butterflies) with approximately 50 species and the Papilioninae with about 650 species. Papilioninae alone occurs in peninsular India. However, its taxonomy is a little complex with many tribes, groups and distinct subspecies. A simple description of Swallowtails is given below for the distinct groups which are represented in peninsular India.

1. **The Birdwings and Roses** These belong to two genera (*Troides* and *Pachliopta*), with four species in peninsular India, one Birdwing and three Roses. The Birdwing has black wings with yellow markings, the Roses have black wings with white and red spots. The hind wings are not tailed in the Birdwing, but tailed in the Roses. The Roses have bright crimson bodies, hence, together with their Himalayan relatives, they are called "red-bodied Swallowtails".

   They occur in open places in deciduous and evergreen forests. They have broad wings and a leisurely flight. However, the flight is long sustained and the butterflies fly high up in the air when travelling long distances. The body is bulky with a large abdomen.

   The adults feed only on nectar. The caterpillars feed exclusively on climbers and creepers of family Aristolochiaceae.

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They are fat and almost uniform in girth. The segments possess fleshy protuberances. The caterpillars are a vivid maroon-red and are marked with a yellowish-white band. The pupae are thick and bent, with prominent toothed or winged projections on the abdominal segments.

Since these are unpalatable species, the Roses have mimics in the form of the Common Mormon females. A few day-flying and crepuscular moths also resemble them in flight. The Birdwing, however, does not have any mimics, possibly because it is too large.

2. **The Jays, Bluebottles and Swordtails** These belong to a single genus, *Graphium*, with five species in peninsular India. Jays and Bluebottles are black butterflies with green or blue spots and short tails. Swordtails are white with black bands, marked red or green and with long, thin, pointed, sword-like tails. The males have a distinct fold at the inner (lower) margin of the hind wing, which contains fluffy scent scales that attract the females.

They inhabit evergreen forests. The Jays have taken to urban areas as well, because two of their larval host plants are grown in gardens. The Spot Swordtail occurs in the deciduous forests. These species possess narrow and triangular wings. They have a swift flight with extremely rapid wingbeats. The Jays and Bluebottles spend most of their time flying in the canopy, although they do sometimes descend to the ground.

Most of them are fond of nectar and mud-puddling, but the Tailed Jay feeds exclusively on nectar. The mud-puddling individuals usually form groups of their own species, or join groups of other *Graphium* species. It is somewhat unusual to find them mud-puddling with butterflies from other groups.

The caterpillars feed on plants of the families Lauraceae ("laurel and cinnamon" family), Annonaceae ("custard apple" family) and Magnoliaceae ("champaka" family). They are smooth, uniform bright green and unmarked, but sometimes blotched with darker green or with smaller yellow rings and bands on the thoracic segments. While resting, their heads are bowed and applied closely to the leaf, the second segment covering the head from above. The thoracic (particularly 3rd and 4th) segments are swollen, the abdominal segments tapering behind them gradually. The young caterpillars have spiny projections on each of the thoracic segments and a pair of similar projections on the last body segment. These projections reduce in size and lose spines in successive instars. The full-grown caterpillars have only small but pointed projections on the 4th and the last abdominal segment. The caterpillars avoid feeding during the day. The osmeterium is pale, glassy green.

The pupae are green with a small projection on the back. There may be light yellow lines on the abdominal segments.

3. **The Mormons** They belong to the genus *Papilio*. There are two species, both very common and have separate species accounts in this book.
4. **The Peacocks** They belong to a single genus, *Papilio*. There are three species of this predominantly tropical Asian group in peninsular India. They are jet black and tailed, heavily dusted on the wings and body with metallic green scales, with a dazzling greenish-blue band on the wings. The males may have horizontally-arranged thick, velvety bands of scent scales on the fore wings.

They occupy evergreen and dense semi-evergreen forests, but the Common Banded Peacock inhabits dry scrub and deciduous forests. They fly fast, mostly along the streamsides, in the canopy and near the ground.

All the species are attracted to flowers and wet soil. However, they usually do

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not form large mud-puddling assemblages.

The caterpillars feed on plants of the family Rutaceae ("lemon" family). They are green with black, yellow and white markings. They are the same shape as the Mormons. The pupae are also similar to those of the Mormons, but without projections on the head.

5. **Rest of the Papilioninae** These also belong to the genus *Papilio* and form further distinct groups if the other species from the rest of India are considered. However, in peninsular India there is only one representative each of these groups, so one cannot make sweeping generalizations. These species are covered in the species accounts, so specific information can be found there.

The groups mentioned above are not compatible with the taxonomic ones. Taxonomically, there are only three groups in Papilioninae as represented in peninsular India: the *Troides* and *Pachliopta* species (the Birdwings and Red-bodied Swallowtails), the *Graphium* species (the "Kite Swallowtails") and the *Papilio* species (the "Black-bodied Swallowtails"). Here, I have broken *Papilio* into three groups because the Peacocks are quite different in their habits from the Mormons, which are different from the Common Mime, Malabar Raven and Malabar Banded Swallowtail.

1. Southern Birdwing

(Plate 8, no. 43)

Scientific Name *Troides minos* Cramer
(Old: *Troides helena* Linnaeus)

Field Characters Wingspan: 140–190 mm. This is the largest of southern Indian butterflies.

UN*

Female UP*

Very large and black, with yellow hind wing

The upper surface of its fore wings is deep black and that of its hind wings is golden-yellow with black wing-borders. The female is similar to the male, but less shiny and has a row of large triangular spots on the yellow areas of the hind wings. In both the sexes the undersides are similar to the uppersides.

Similar Species Other Indian and Sri Lankan species of Birdwings look similar, but none overlap in distribution, or do so only in parts of northeastern India and Myanmar. The Common Birdwing (*Troides helena* Linnaeus) is found in eastern and northeastern India, Myanmar and Andaman–South Nicobar islands. The Golden Birdwing (*Troides aeacus* C & R Felder) is distributed in the Himalayan foothills and Myanmar. The Ceylon Birdwing (*Troides darsius* Gray) is restricted to Sri Lanka.

Status, Distribution and Habitat It is restricted to southern India and is very

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* **Note:** UP represents the upperside of butterflies, and UN the underside.

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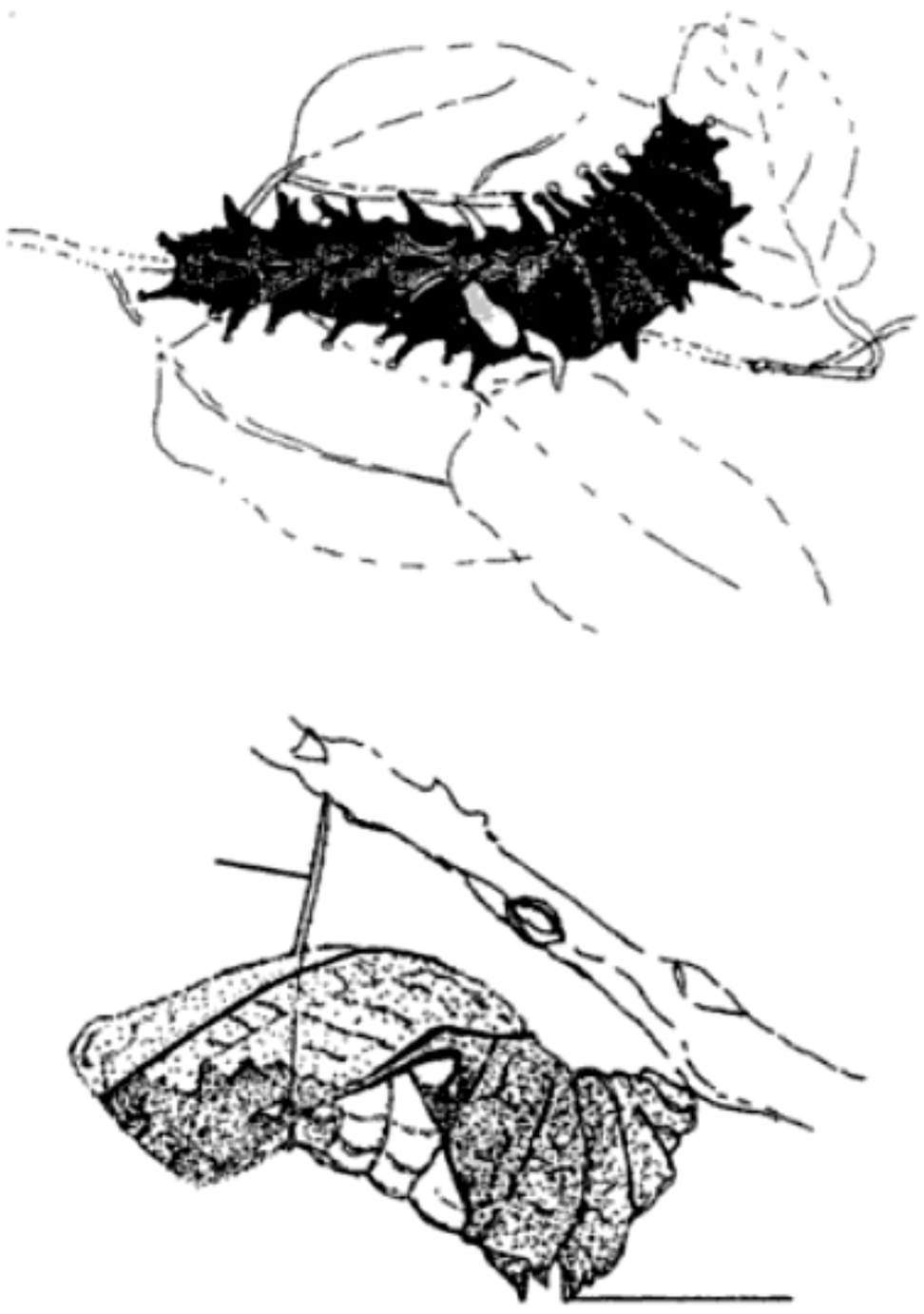
common in many areas of the southern and central Western Ghats. It is also found in southern Maharashtra and northern Goa where, however, it is uncommon. It inhabits diverse habitats from lowland evergreen forests near the coast to mixed deciduous forests, dry scrub and agricultural fields. It is common in the monsoon and post-monsoon months but uncommon in summer.

Habits It usually flies very high, among or above tree-tops in the forests, but sometimes descends to the ground. It flies in a leisurely manner, circling and sailing over the plants. This flight, coupled with its bright colours, advertises the fact that the species is unpalatable to birds and other large insectivorous predators. This unpalatability is due to the presence of aristolochic acids, which the caterpillar ingests while feeding on the leaves of its host plant which contain them. The fluttering of its wings sometimes gives the impression that the butterfly would not be able to fly far, but it is indeed a very determined flier and covers long distances in a single flight. Even while flying in the canopy, it attracts attention because of its extremely large size, the wingspan being larger than those of some small birds, hence the name: "birdwing".

The only food source for this butterfly is flower nectar. Like many other large forest butterfly species that also inhabit gardens and orchards, it has taken to feeding on *Lantana, Ixora* and *Mussaenda*, which are common ornamental garden plants. The butterfly keeps fluttering its wings while feeding but closes them over its back when it rests.

Most of the diurnal butterflies become active in the morning only after the sun-rays raise the ambient temperature. The Birdwing, however, is remarkable in that it starts flying very early in the morning, much before other butterflies and thus may be found feeding earlier than them. The species does not exhibit any special basking behaviour, but its jet-black scales are very efficient in capturing heat.

Reproduction The habitually high-flying Birdwing female flies close to the ground and shrubs in search of the larval host plants, all of which are aristolochiaceous creepers and climbers. The female hovers about the host plant, and lays spherical eggs singly on the edges of the undersides of young leaves and shoots. The little caterpillar lives on the underside of leaves but as it grows fatter and larger, it rests on the underside of stalks and stems. As with the Roses, the caterpillar is extremely slow and uninterested in moving. The caterpillar and pupa, in general appearance, are similar to those of the Common Rose. The caterpillar is velvety maroon-red with a shiny black head. It has four rows of long, fleshy and bright red tubercles—two subdorsal and two spiracular. The dorsal surface of the segments is shiny. The back has grey markings and there is a broad, oblique, pinkish-white band on the 7th and 8th segments. The abdominal segments bear flattened outgrowths. The pupa is pale brown or green, marked with fine brown striations and minute markings. It is found on the undersides of leaves,



Length of caterpillar: 90 mm. Length of pupa: 50 mm.

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twigs, etc. If touched, it makes hissing sounds by rubbing together the 8th, 9th and 10th abdominal segments and swaying from side to side.

The caterpillars are heavily parasitized by tiny Braconid wasps. Dozens of Braconid larvae, after eating the Birdwing caterpillar from inside, puncture the skin, wriggle out and make whitish cottony cocoons on the body of the caterpillar. After the Braconids pupate the caterpillar does not feed, but remains alive and motionless for a few hours or even days.

Larval Host Plants The host plants are small climbers and creepers of the family Aristolochiaceae, which grow in openings in the forests and on fallow lands: *Aristolochia indica, A. tagala* and *Thottea siliquosa*.

Economic Importance Various species of Birdwings are among the most sought-after butterflies all over the world by butterfly lovers and collectors. Fresh and undamaged specimens command a high price. However, the Southern Birdwing is apparently not as popular as the other Birdwings, possibly because of its restricted distribution and because similar-looking species occur in other regions.

Suggestions for student projects Since this species is common around human habitations in south-western India, the following project can easily be undertaken by students and amateurs in nearby areas: Monitoring adult and larval populations of the Birdwing over the seasons and years. Studying seasonal and yearly population trends, levels of parisitization, mortality caused due to parasitoids and other factors, etc. can give valuable insights into the ecology of this butterfly.

2. Common Rose

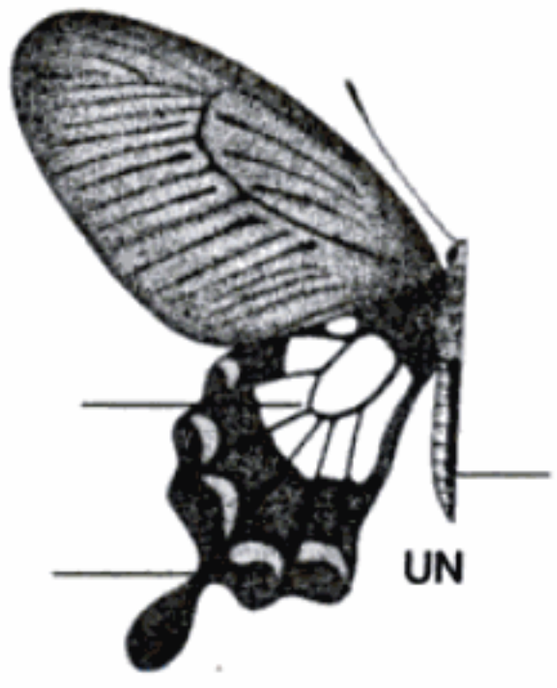
(Plate 8, no. 44)

Scientific Name *Pachliopta aristolochiae* Fabricius (Old: *Tros aristolochiae* Fabricius)

Field Characters Wingspan: 80–110 mm. It is a black butterfly with a crimson body. There is a large white area on the hind wings. A series of deep red or brownish-red spots are present on the outer margin of the hind wings. The sexes look alike.

Similar Species The Crimson Rose is a similar species which is larger, brighter and has two white central bands on its fore wings.

Large and black, with red and white spots and red body.



Malabar Rose

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The Malabar Rose (*Pachliopta pandiyana* Moore) has a much larger white patch on its hind wings. It is found only in the southern and central Western Ghats.

The female of the Common Mormon (form *stichius*) mimics this species (for its description, refer to the Common Mormon).

Status, Distribution and Habitat It is distributed all over the Oriental Region and is very common throughout India. It is found mainly in open, cultivated areas, scrub and deciduous forests. A common visitor to garden flowers, it is also seen in most crowded cities. It is more frequent during and after the rains, being less common during very cold or very hot periods of the year.

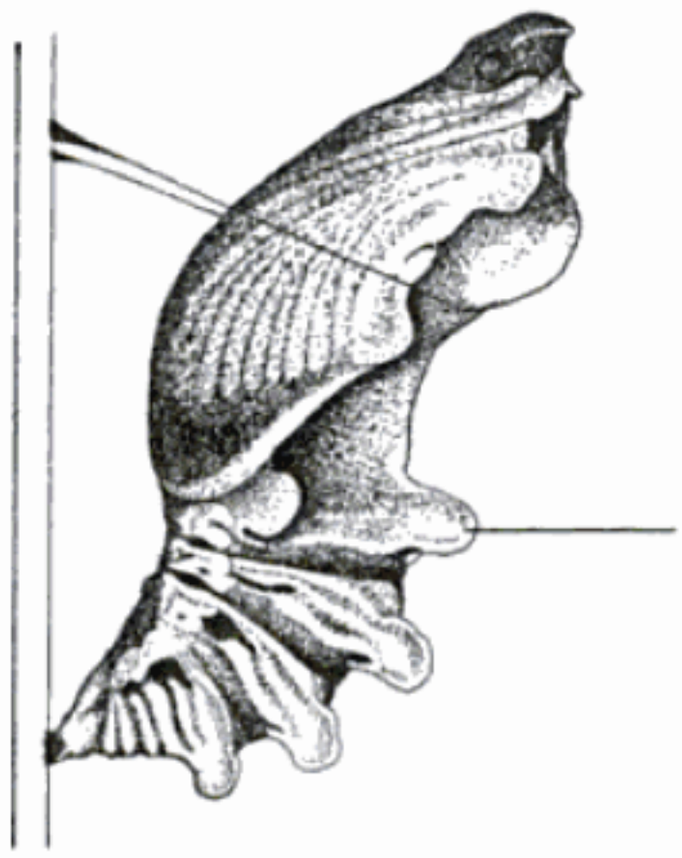
Habits The flight of some Swallowtails is interesting, with the long fore wings being used for propelling the body in flight and the hind wings mainly for balancing and steering. The Common Rose is one example of this, and the flight style is distinctly evident when the butterfly is feeding from flowers. At this time, the fore wings are flapped continuously and the hind wings are moved only a little to control the movement of the body. The flight is slow but straight and long-sustained. The butterfly flies usually not more than 3–4 m above the ground when it is searching for flowers or for the larval host plant. However, when it travels long distances, it flies up to 10–15 m above open ground and slightly higher when flying over the forest.

It is hard to kill this butterfly, as is true of all the other unpalatable species. It will not die easily if the thorax is pinched, a common method employed by butterfly collectors to immobilize and kill butterflies, and survives mishandling. It will bounce and fly out of reach of any net at the first chance available, but with the same unhurried manner as if it had never been caught!

This butterfly is fond of flowers, especially of *Lantana, Cosmos, Zinnia*, etc. and visits wet soil only occasionally.

Early in the morning, it can be seen basking near tree-tops with its wings spread out.

Reproduction The female takes a long time fluttering around and investigating the host plant to confirm that the plant has abundant young leaves for the ever-hungry caterpillars. The eggs are laid on the underside of leaves of *Aristolochia*. The egg is round and reddish. The caterpillar is a velvety maroon in colour with a whitish band on its abdominal segments. This band is more prominent in the advanced stages of the caterpillar. The caterpillar has



Length of caterpillar: 30 mm.
Length of pupa: about 25 mm.

fleshy protuberances on the body, is bulky and slow in its movements. The pupa is brownish and held at an angle to the support, generally a stick, by means of a body-band. It looks unusual due to the large flat, semi-circular projections on the back of the abdomen, thorax and head.

The caterpillars, and hence the butterflies, are protected because of the pungent-smelling aristolochic acids found in their host plants. They smell and taste unpleasant and predators soon learn to avoid them. However, in spite of their unpalatibility to birds and reptiles, the caterpillars are vulnerable to

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parasitoid attacks. The Braconid wasps that parasitize Southern Birdwing caterpillars also parasitize the caterpillars of the Common Rose. The aristolochic acid defenses of their host are of no use against the wasps as the wasps also have evolved along with their host in such a way that the acids have no adverse effect on them.

Larval Host Plants The caterpillars feed on creepers and climbers: *Aristolochia bracteolata*, *A. indica*, *A. tagala* and *Thottea siliquosa* (Aristolochiaceae).

Suggestions for Student Projects

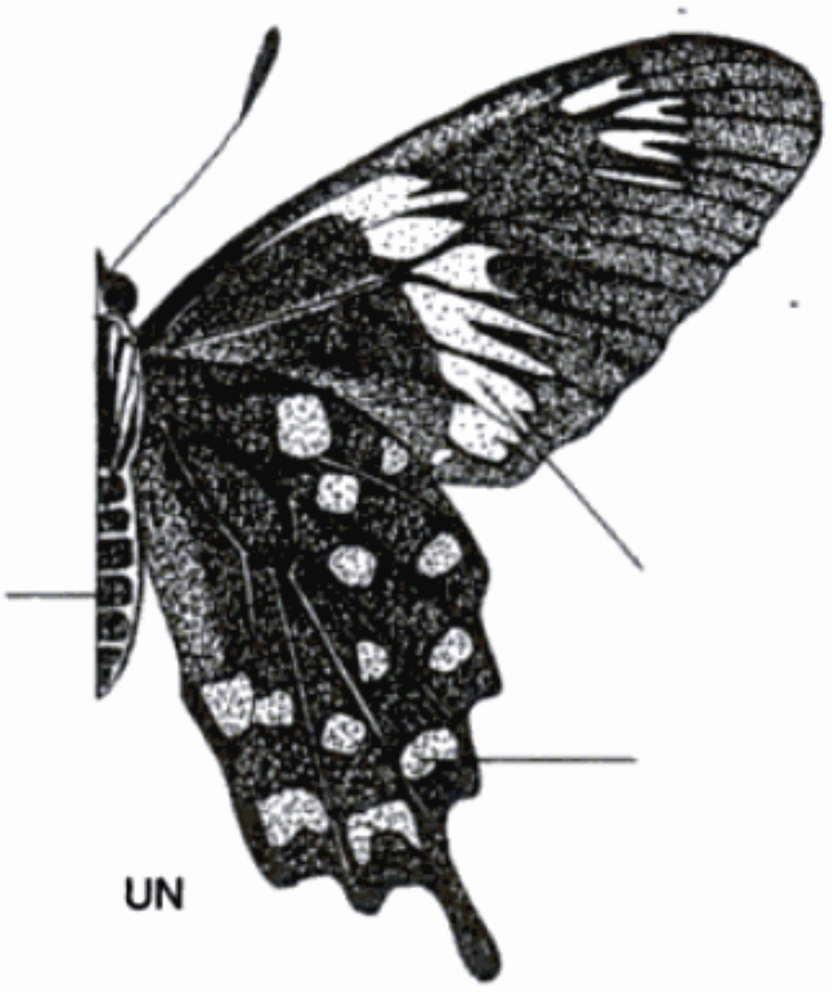
1. Find out the ratio of the Common Rose to Common Mormon females in your area. Does this ratio vary in local populations?
2. Find out what the anatomical adaptations are which make this species tough and hardy—a common characteristic of all unpalatable butterflies.

3. Crimson Rose

(Plate 8, no. 46)

Scientific Name *Pachliopta hector* Linnaeus
(Old: *Tros hector* Linnaeus)

Field Characters Wingspan 90–110 mm. The Crimson Rose is a large, glossy, black butterfly with two broad white bands on the fore wings. The tailed hind wings have bright crimson spots. The uppersides and undersides of the wings are similar in markings. The body is a gaudy crimson in colour. The female is somewhat dull.



Large, black with red spots and white bands and red body

Similar Species The Common Rose has elongated white spots on the hind wing, but lacks the white bands on the fore wing. The form *romulus* of the Common Mormon female, a mimic of the Crimson Rose, has a black body, is smaller in size and duller in colour.

Status, Distribution and Habitat This butterfly is very common south of the Godavari river and mainly at lower elevations. Its range extends along the coast of Orissa, south Bihar and West Bengal into Sikkim and parts of northeast India. It is abundant from late monsoon to late winter, but may be found in smaller numbers throughout the year. It occurs mainly in the dry deciduous forests and thick scrub, but may also be found in disturbed semi-evergeeen and evergreen forests. This is a species restricted to mainland India and Sri Lanka, although it has also been recorded from eastern Myanmar and the Andaman islands.

Habits Like the Common Rose, the Crimson Rose has a slow, fluttering but steady flight. However, it flies slightly faster, stronger and at a greater height from the ground.

It is a regular visitor of flowers, and nectar probably plays a decisive role in its egg-production. The higher intake of nectar may be augmenting egg-production. The flowers of

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Lantana, a shrub which has now infested vast patches in disturbed dry and moist deciduous forests of southern India, is its favourite nectar plant. The butterfly is very common wherever large patches of flowering *Lantana* occur.

It basks with its wings spread flat. Sometimes small congregations of basking individuals may be formed, often at 10–15 m up in the trees. While resting, the fore wings are half-drawn between the hind wings. The butterfly sleeps on slanting, outstretched branches of shrubs, small trees, etc.

It has strong migratory habits. Massive congregations of up to several thousand individuals may be found at the end of the peak season for the species. These then migrate to other areas.

Reproduction It is similar to the Common Rose. The caterpillar is purplish-black or blackish-brown with a black head and orange osmeterium. The body is fat, with orange-red tubercles, and a transverse yellowish-white band on segments 6 to 8 is very prominent.

The pupa is pinkish-brown with darker, expanded wing-cases. The wing-like expansions on the abdomen are distinctive.

Length of caterpillar: 45 mm. Length of pupa: 30 mm.

Larval Host Plants The caterpillars feed on *Aristolochia bracteolata, A. indica* and *Thottea siliquosa* (Aristolochiaceae).

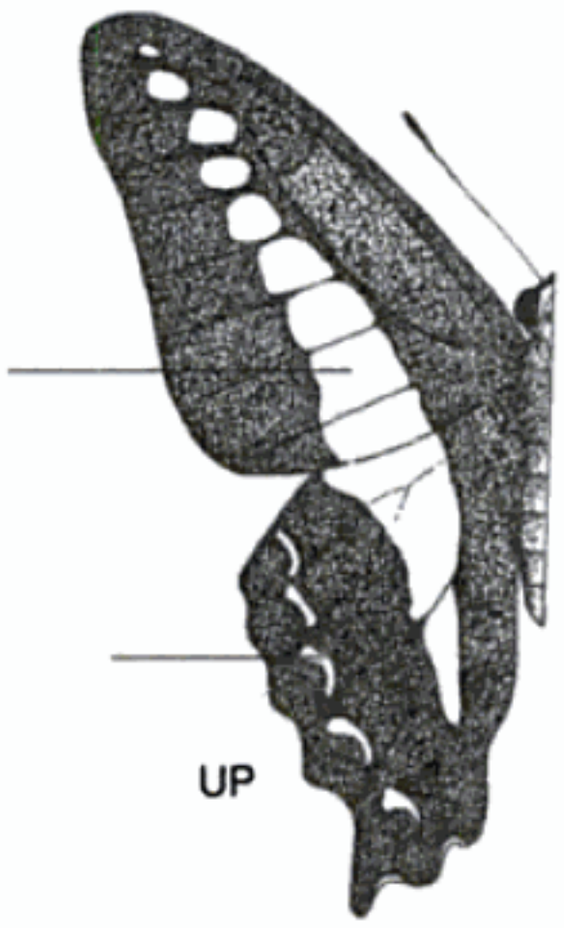
Contributed by *K Gunathilagaraj*

4. Common Bluebottle

(Plate 8, no. 48)

Scientific Name *Graphium sarpedon* Linnaeus (Old: *Zetides sarpedon* Linnaeus)

Field Characters Wingspan: 80–90 mm. The upperside is black with a greenish-blue central band. The wings are pointed. The hind wings have a row of submarginal crescent-shaped blue spots. The underside of the wings is brown, the blue band paler, with some red spots. The female is paler with slightly broader wings.



Large, black with a dark blue band

Similar Species The Common Jay is pale blue, with blue spots surrounding the central blue band.

Status, Distribution and Habitat It occurs in the evergreen and semi-evergeen forests and is very common on the forest paths, streamsides and edges. It is found mainly at low elevations but may be seen up to 2, 300 m in the Himalayas. It occurs in southern India in the Western Ghats and in the Himalayas from Kashmir eastwards. Its global distribution extends over the Oriental and Australian regions.

Habits The Common Bluebottle is a nervous butterfly, settling seldom and only momentarily. It flies fast with rapid

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wingbeats. Although it occurs in all the vegetation layers, it spends most of its time in the canopy of the tall forest trees.

It feeds on nectar. Similar to the Tailed Jay, it visits flowers hurriedly and its wings quiver, in order to balance and move the body, while feeding.

The males congregate in large numbers for mud-puddling. They also come readily to natural baits such as rotting insects.

Reproduction The egg is yellowish, laid singly on the leaves of the host plants. The young larva is black or dark green with many spines. The grown-up larva is green with a pair of short spines on each thoracic segment and the last segment. There is a yellow transverse band on the 4th segment, and a lateral band on the body. The caterpillar usually lies in the middle of the leaf on the upper surface and is very sluggish.

The pupa is green with a slender and pointed thoracic projection, yellowish wing-cases and lateral bands.

Larval Host Plants The caterpillars feed on plants of family Lauraceae and Annonaceae. The plants include *Alseodaphne semecarpifolia*, *Cinnamomum camphora*, *C. macrocarpum*, *C. malabatrum*, *Litsea chinensis*, *Miliusa tomentosa*, *Polyalthia longifolia* and *Persea macrantha*.

Suggested Student Projects Many larval host plants are reported for this species. Probably different plant species are used in different areas. The students may study local preferences of larval host plants. Study of usage of the indigenous versus introduced lauraceous plants may also be useful.

Length of caterpillar: 28 mm. Length of pupa: 31 mm.

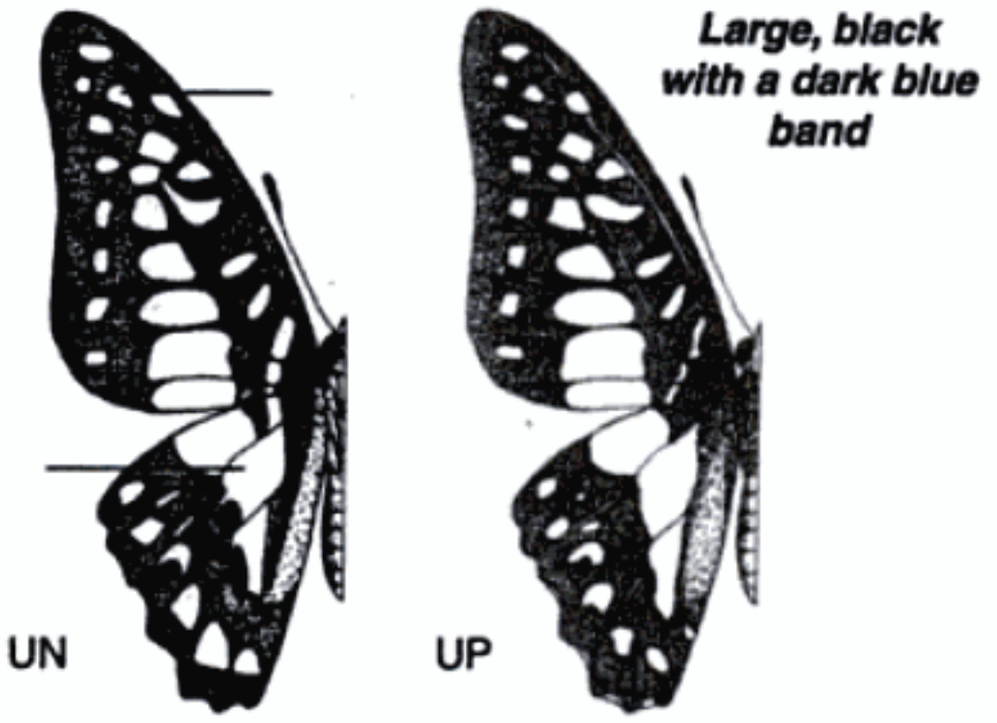
Contributed by *K Gunathilagaraj*

5. Common Jay

(Plate 9, no. 49)

Scientific Name *Graphium doson* C & R Felder (Old: *Zetides doson* C & R Felder)

Field Characters Wingspan: 70–80 mm. This is a black butterfly with a pale blue, semi-transparent central band that is formed by large spots. There is a marginal series of smaller spots. The underside of the wings is brown, with markings similar to the upperside, but they are whitish. The sexes look alike.



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Similar Species The Common Bluebottle is brighter blue and lacks the series of marginal spots present in the Common Jay.

Status, Distribution and Habitat The Common Jay is common in the thick, riparian, moist deciduous, semi-evergreen and evergreen forests. It inhabits primary as well as secondary forests, sometimes venturing into forest plantations and orchards situated in the midst of forests. It particularly frequents forest streams and rivers. It is active throughout the year, but more so in the summer. It is distributed at lower elevations in the Sri Lankan and southern Indian forests, including suitable localities in the Eastern Ghats and Satpuras. It extends to Bengal and Assam in the east, the Himalayan foothills to the north and then throughout southeast Asia.

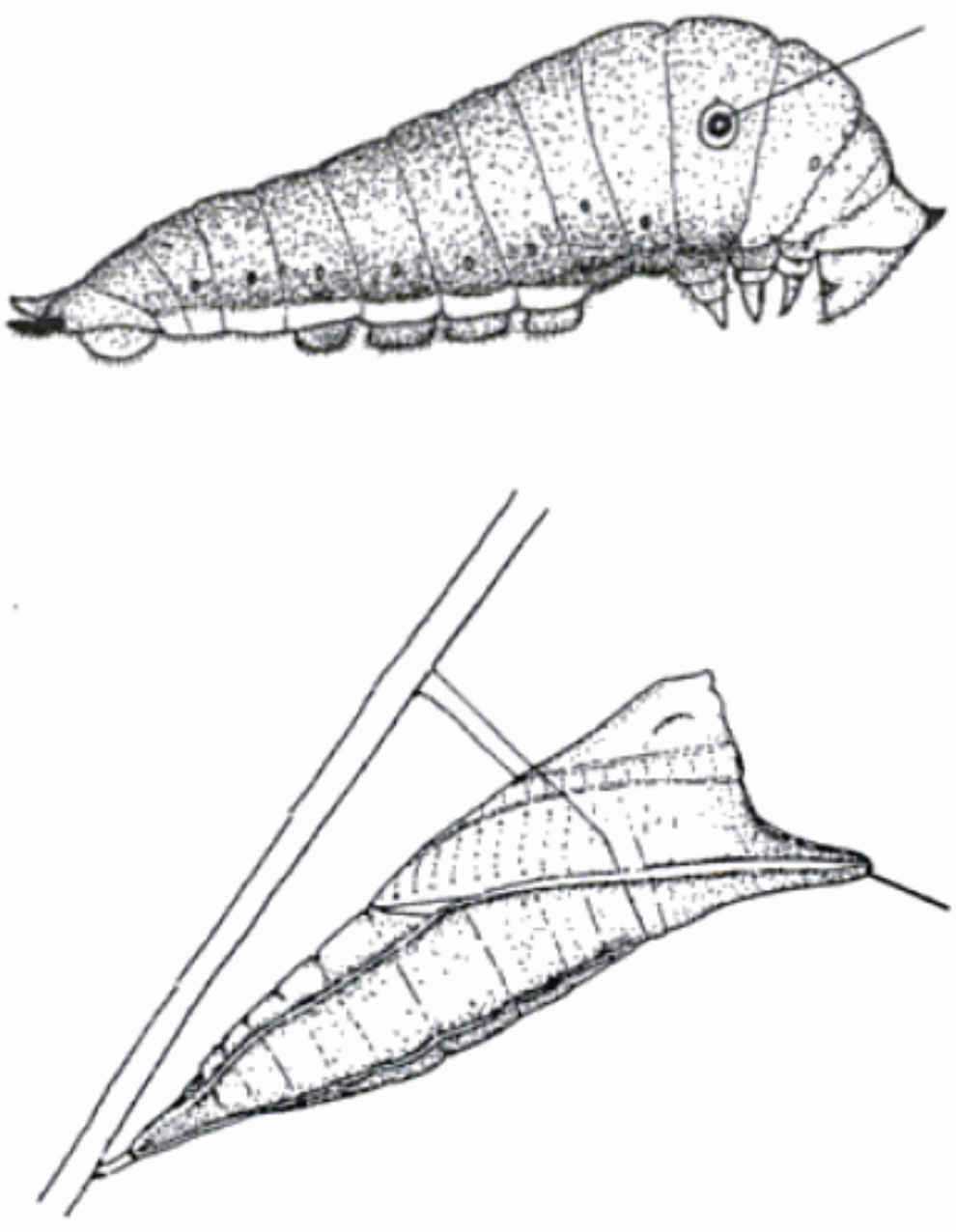
Habits This butterfly is active throughout the day, and constantly on the move, so it is difficult to see it settled down. It has a swift and straight flight and avoids no vegetation layer. Its thorax is strong, so it rapidly beats its wings, not fully lowering them in each beat. It can easily travel between the ground and the canopy of the 40 m tall evergreen forests. The resources of the adults are distributed thoughout this vertical range. They range from the mud-puddling sites of the males at the forest streams to large shrubs such as *Leea,* to medium-sized trees such as *Cinnamomum* and large canopy trees. While feeding from flowers, it keeps its wings vibrating, never fully settling on the flowers.

The males gather at mud-puddling sites and usually form their own species assemblages or join other Swallowtail butterflies. The group is a very tight one, so the members push against each other in an effort to shift to spots in the surrounding of their original positions. Before retiring in the evening, the butterfly spends a prolonged period investigating and hovering to choose a particular branch to sleep. At rest the wings are closed over the back, but the hind wings do not cover the fore wings.

Reproduction The egg-laying behaviour is very similar to that of the Tailed Jay. The habits and host plants of the caterpillar and place of pupation are also similar.

The egg is spherical and pale yellow. The young larva lacks the yellowish markings present on the back of the Tailed Jay, and the white line above the prolegs is broader. The grown caterpillar has two forms. It is either dark brown or grassy green, with spines on the 4th segment short, conical and blue-centred. They are surrounded by broad lemon-yellow rings which, in turn, are surrounded by thin black rings. The osmeterium is pale bluish-green and extruded only reluctantly.

The pupa is pale green with a dark purplish median line from the head to the thoracic horn and a yellow line from the tip of the horn to the cremaster.



Length of caterpillar: 30 mm. Length of pupa: 22 mm.

Larval Host Plants The caterpillars feed on *Annona lawii, Cinnamomum macrocarpum, Magnolia grandiflora, Michelia champaca, Miliusa tomentosum* and *Polyalthia longifolia* (Annonaceae, Lauraceae, Magnoliaceae).

Contributed by *K Gunathilagaraj and Krushnamegh Kunte*

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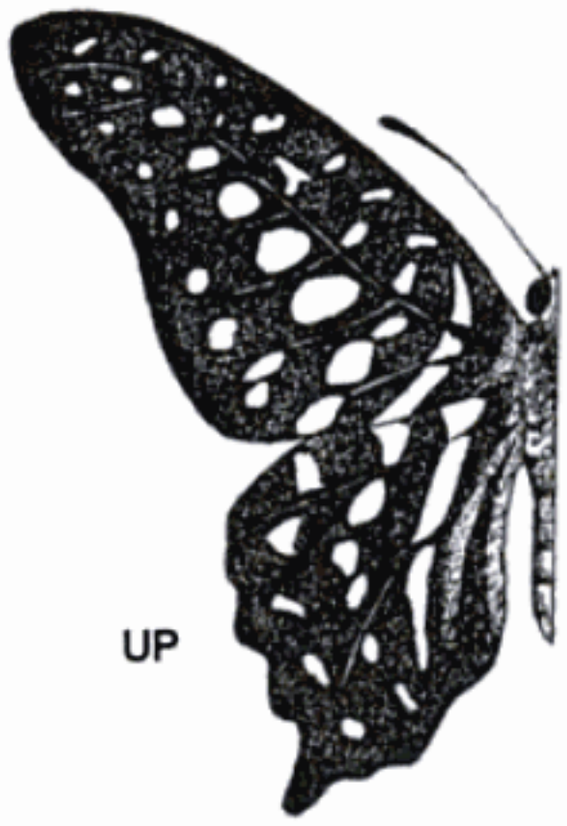
6. Tailed Jay

(Plate 9, no. 50)

Scientific Name *Graphium agamemnon* Linnaeus (Old: *Zetides agamemnon* Linnaeus)

Field Characters Wingspan: 85–100 mm. It is a black butterfly with apple-green spots and streaks on its wings. The wings are more elongated and narrower than in other groups of Indian Swallowtails. The tails on the hind wings are longer in the female. The male has a patch of scent scales consisting of an elongated tuft of hairs on the dorsal fold of the hind wings, but this is rarely visible in the field.



Large, black, with apple-green spots

Status, Distribution and Habitat The Tailed Jay was once strictly a forest-dweller. Now, due to extensive cultivation of *Annona*, *Polyalthia* and *Michelia* plants, which are its larval host plants and also the nectar plants in gardens, it is often seen in urban areas as well. However, it is more common in its native evergreen and wet semi-evergreen forest habitats. It is active throughout the year, but its abundance may vary regionally depending on the local monsoon pattern and available larval host plants.

It is distributed in the entire Indian subcontinent as well as parts of southeast Asia.

Habits In the animal world, there is a general rule that all birds, mammals (bats) and insects with long, narrow and pointed wings are masters of speed and the fastest always belong to this category. This applies to the Tailed Jay as well. Its flight is straight and dashing. In the forests it flies among the tree-tops, descending occasionally to feed from flowers of shrubs and small trees. The females may do so in search of larval host plants. However, it is far more common in the forest canopy than near the ground and since the canopy is very high and too dense in its forested habitats, its abundance is usually underestimated. In gardens it usually flies at the level of bushes but at the sight of an obstacle or any attacking predators, it darts swiftly and strongly to the tree-tops where in flight-speed and control it beats some of the best fliers such as the bee-eaters.

This is an extremely restless butterfly, never tired of flying. It starts its activity in the morning and ends late in the afternoon. When it is active, it is always on its wings or at the flowers. Even when it feeds from a flower, it barely touches it with its legs, takes short sips of nectar and flies over to the next flower. It quivers its wings constantly while feeding. Garden flowers, such as *Lantana*, red-flowered *Ixora, Mussaenda*, etc. are regularly visited. However, unlike others of the genus, it is not fond of visiting wet soil.

In the evenings or late afternoons this butterfly may be seen lingering around overhanging or outstretched branches of a tree. These flights are particularly long-lasting compared to those of other butterflies, and are pre-roosting confirmations that the site is safe for the night. At rest, the wings are kept closed over the back, but the fore wings are not drawn between the hind wings.

Reproduction The male courts a female, which rests on a leaf high up on a tree, by hovering behind her. If the female is reluctant

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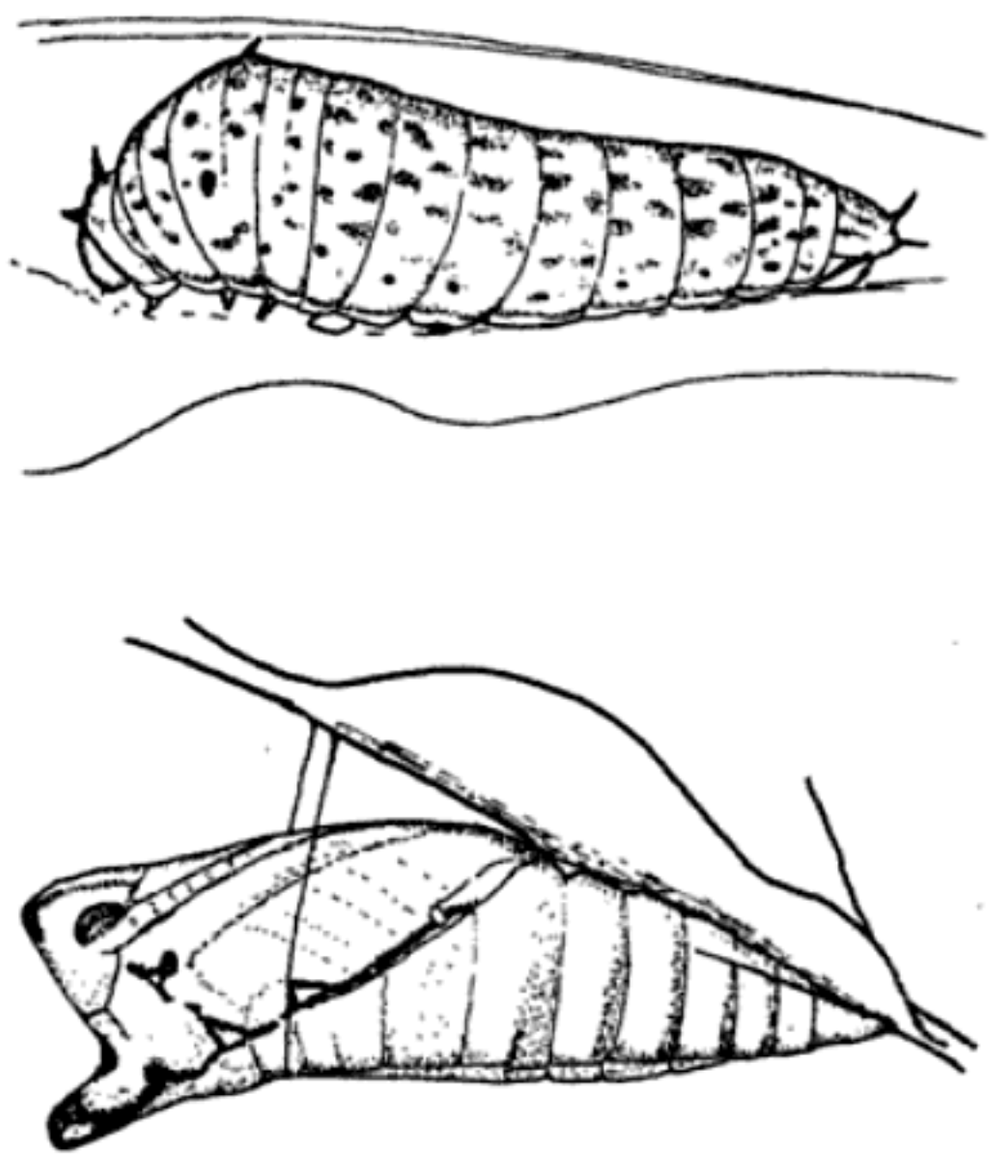
to mate, it tries to avoid the male by flying upwards in the air. The male follows her while circling vigorously around her. This ends in the female suddenly 'crashing' down and taking refuge in the shade. If the courtship and mating are successful, in due course the female lays eggs in the usual hurried manner. The egg is round and greenish-yellow. The caterpillar is somewhat spindle-shaped and has a pair of small projections on each of the thoracic and the last body segments. These projections are distinct in the early instars and as the caterpillar grows old, in later instars they become obscure. The osmeterium is green. The tiny larva is dark green or brownish-green with a whitish-yellow or pale green marking on the back, near the posterior end of the abdomen. It has been occasionally referred to it as a mimic of bird-dropping, but in this respect it is not as perfect as the caterpillars of Common Mormon and Lime Butterfly. The caterpillar rests on the upperside of a leaf with its head usually pointing towards the petiole. After the initial instars it becomes completely green, the shades of which vary. Sometimes it may be mottled with darker green spots. For the young caterpillar the tender leaves are available only on the peripheral young shoots of the tree and it is found on such reddish-green young leaves. Later, when it changes colour to green, it hides among dark-green leaves at the core of the foliage.

Before pupation the caterpillar turns light green. As a rule, pupation takes place at night. The pupa is plain green and has a short projection on the back of the thorax, the tip of which is brown. The growing caterpillars are heavily attacked by parasitoid wasps. The female wasp lays eggs inside the caterpillar and the parasitoid larvae feed inside the caterpillar. This results in the caterpillar's death. But the caterpillar rarely dies before pupation, therefore it provides a shelter for the wasp larvae to pupate. After their development is complete, the adult wasps emerge from their own pupae which are



Length of caterpillar: 38 mm. Length of pupa: 29 mm.

situated inside the Tailed Jay pupa. The parasitized pupa turns brown after 3–4 days of pupation.

Larval Host Plants The caterpillars feed on tall wild trees and cultivated small trees, belonging to the families Annonaceae, Lauraceae and Magnoliaceae. The reported species are *Annona discolor, A. muriacata, A. reticulata, A. squamosa, Artabotrys hexapetalus, Cinnamomum* spp., *Michelia champaca, Miliusa tomentosum, Polyalthia cerasoides* and *P. longifolia*.

Suggestions for Student Projects 1) Identify parasitoids of the Tailed Jay. Find out how many species infect it and how many of them, if any, depend exclusively on it. 2) Collect full-grown caterpillars of the Tailed Jay from your area and calculate percentage of the caterpillars that die due to parasitoid infections.

Calculate the average parasite load in terms of number and species of parasitoids per infected caterpillar. Is it correlated to the stage (instar) and population density of the Tailed Jay caterpillars?

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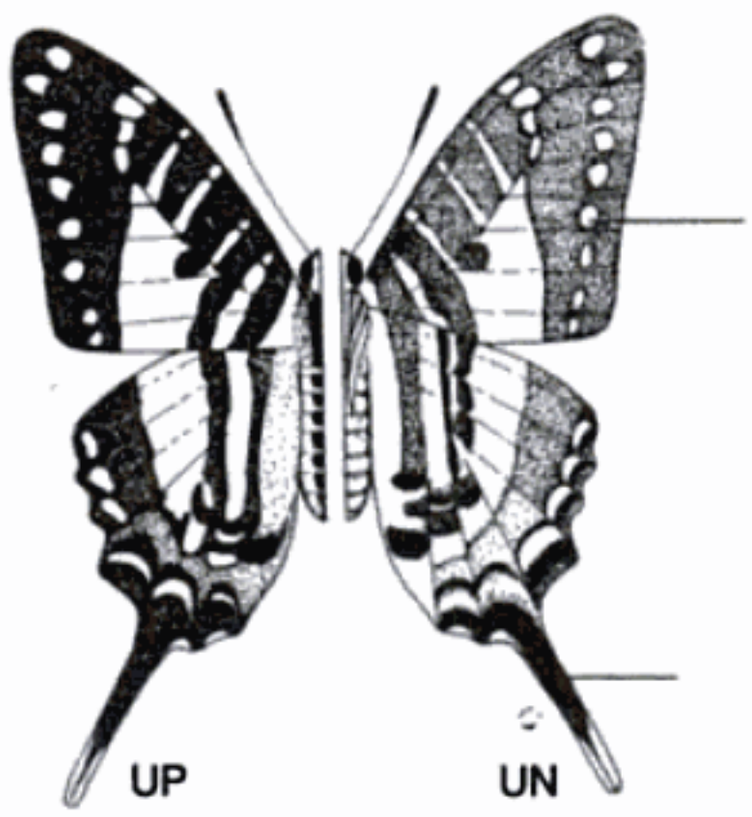
7. Spot Swordtail

(Plate 9, no. 51)

Scientific Name *Graphium nomius* Esper
(Old: *Pathysa nomius* Esper)

Field Character Wingspan: 75–90 mm. This species is unmistakable due to the very long, straight, sword-like tails on its hind wings. The butterfly is white with a broad, white-spotted brown (underside) or black (upperside) outer wing margin of both its wings and additional bands on the wings. On the underside a series of red spots at the centre of the hind wings is prominent. The sexes look similar.



Large, black and white with a long tail

Similar Species The Fivebar Swordtail (*Graphium antiphates* Cramer) is found commonly in the wet evergreen forests of central and southern Western Ghats and in northeastern India. It is slightly larger in size and lacks the broad margin and red spots on the wings, which are prominent in the Spot Swordtail.

Fivebar Swordtail

Status, Distribution & Habitat The Spot Swordtail is most common in the dry summer months and in deciduous forests. It occurs more commonly along stream-beds or other relatively moist places in the forests where the vegetation is green. However, it is a powerful flier, which may occasionally be found away from the riparian patches or even from the forests. The individuals are active from February to June, being most abundant in March-April and disappear with the onset of the monsoon. The species is found usually below an altitude of 1, 000 m, but may go up to 2, 000 m. Inside Indian limits it occurs in deciduous forests throughout the Western and Eastern Ghats, Satpuras, in the Shivaliks and along the Himalayan foothills to northeastern India. It extends into Myanmar and other eastern parts of the Oriental region.

Habitat During the hot summers and after pre-monsoon showers, butterflies concentrate mainly around riparian areas in the forests and their activity is maximum at the wet soil patches. Butterflies settle on wet sand in the forest streams to mud-puddle. The Spot Swordtail is among the most impressive of the butterflies that commonly visit butterfly assemblages on wet soil. It often forms a smaller group of its own. Before settling it flies for some time around the patch and chooses where to land. It flies in the most hurried manner, swift and straight. It suddenly lands on a wet patch, sucks water, walks a few steps, checks another spot and takes off. It is very restless by nature and even while drinking its wings quiver. It is wary and takes off at the slightest disturbance, never to return. Its flight course consists of slight ups

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and downs, which becomes more erratic if the flight is disturbed. On particularly promising mud-puddling patches, however, once settled, it spends some time engrossed in feeding and is somewhat tolerant to movements around it.

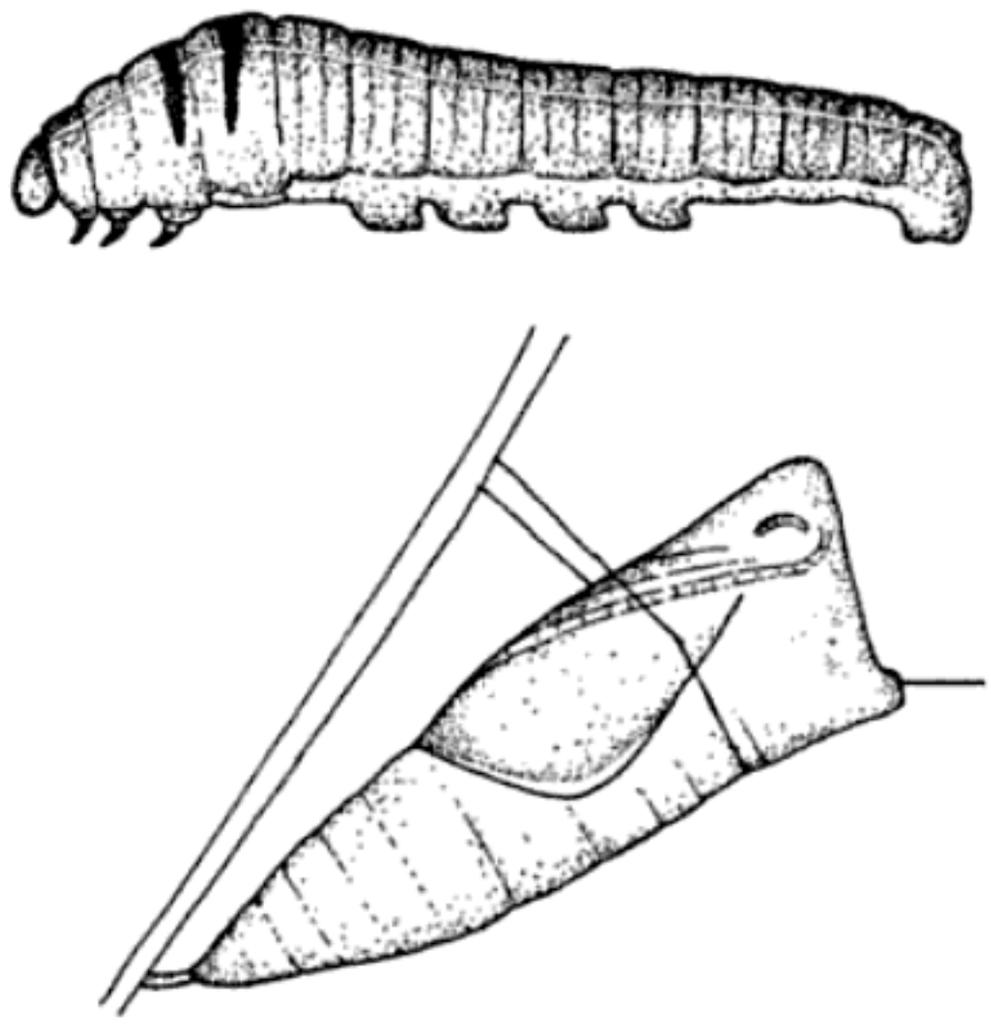
It is not seen feeding from flowers very often, but it searches for them at all heights above the ground. It visits flowers of shrubs and large trees, and a large number of individuals may gather to feed on a big flowering tree. *Gmelina arborea*, a deciduous tree from dry areas, is a favourite.

It basks close to the ground, while sitting on herbs or shrubs, with its wings partially or completely spread.

Reproduction The annonaceous host plant, *Saccopetalum tomentosum,* is a deciduous tree. It sheds leaves in the spring and summer months and bears tender, fresh ones profusely before and during the pre-monsoon showers. This is the peak reproductive period for this butterfly. Just before the new shoots are produced, the dormant pupae formed the previous year yield butterflies. The newly emerged butterflies seek mates and lay eggs on the new stocks of leaves which grow quickly.

The eggs are laid singly on the upper surface or at the margin on the underside of young leaves or buds. The egg is spherical, slightly shiny and yellowish. The caterpillar stays on the upperside of the leaves and sits near the midrib. It eats a leaf from the sides, but moves to another before the leaf is completely eaten. It is grass-green with a sub-spiracular yellow line. A dorsal, broad, olive-green band is present, but may be reduced to a thin line. A brown interrupted lateral line borders this green band. The osmeterium is glossy green. The caterpillar is sluggish and reluctant to move and feeds mainly in the evening and night.

Pupation takes place near or on the ground, under a stone or among fallen and dry leaves. The caterpillar does not wander far and turns pinkish as it waits for pupation. The pupa is similar to that of the Tailed Jay. There are two distinct short, thick processes on the head and a short circular one on the back. The surface of the pupa is slightly rough. It is pinkish-brown and blends well with its surroundings. Butterflies that are in the pupal stage at the end of June (before the monsoon) remain dormant until the next breeding season the next year.



Length of caterpillar: 32 mm. Length of pupa: 26 mm.

Larval Host Plants A large deciduous tree of the family Annonaceae, *Miliusa tomentosum*, is the larval host plant. It is found along water courses and on well-watered soil in the dry deciduous and moist deciduous forests. *M. veluntina* and *Polyalthia longifolia* are also used.

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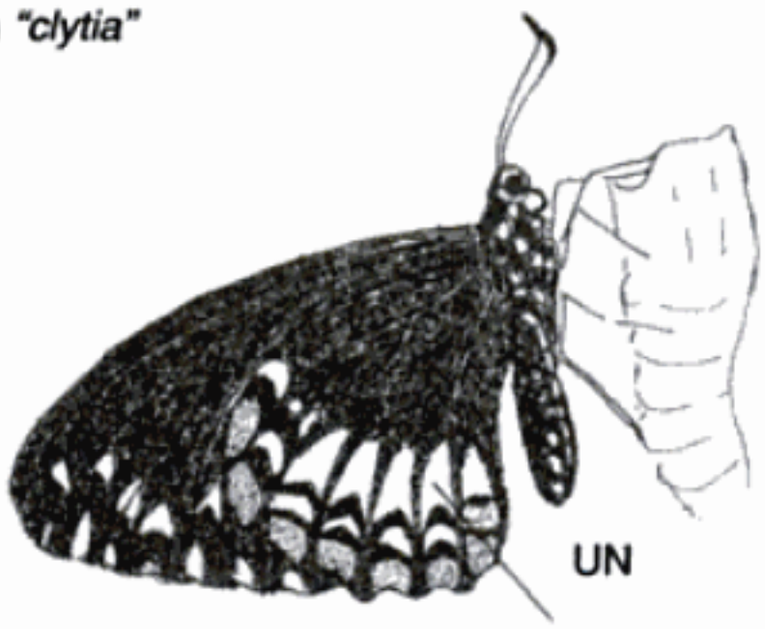
8. Common Mime

(Plate 22, no. 131 & Plate 20, no. 118)

Scientific Name *Papilio clytia* Linnaeus
(Old: *Chilasa clytia* Linnaeus)

Field Characters Wingspan: 90–120 mm. This tail-less Swallowtail has two forms: *clytia* and *dissimilis*, in both the sexes. The form *clytia* mimics the Common Indian Crow and form *dissimilis* mimics the Blue Tiger. The *clytia* is dark brown with two series of white spots at the edges of its wings. The inner series on the hind wing is composed of elongated, arrowhead-shaped spots. The form *dissimilis* is white with broad black stripes. Both the forms have cream-coloured or yellow spots at the margin of the hind wing. This character is unique to the species, which helps in distinguishing it from its models and other mimics. The male and female look alike.

Form *"clytia"*



Large, black with white and cream-coloured spots. Mimics Common Indian Crow

Form *"dissimilis"*

Large, black with white markings. Mimics Blue Tiger

Similar Species The Common Indian Crow and the Blue Tiger are the models. The Malabar Raven has a white spot at the end of the cell on the fore wing.

Status, Distribution and Habitat This is a butterfly of the hilly regions, but mainly at low elevations. It occurs in the dry deciduous and moist deciduous as well as semi-evergeen forests, and more frequently in riparian patches. It is plentiful in the pre-monsoon and monsoon seasons but rare at other times. In India it is most common in the central Indian hill-ranges and also in the Western Ghats and Eastern Ghats, along the Himalayan foothills and in the northeastern states. It occurs throughout the Oriental region.

Habits The Common Mime flies with a continuous fluttering of its wings, much like the Blue Tiger. The wingbeats are neither fast nor strong. It flies both near the ground and in the canopy, but spends most of its time near shrubs and small trees.

It feeds mainly from flowers of shrubs and small trees. In summer months, individuals may join mud-puddling assemblages on sandy banks of streams.

It basks with its wings spread flat or closed. When at rest, however, the wings are closed over the back and the fore wings are half drawn into the hind wings. It sleeps on the slanting branches of shrubs.

Reproduction A boom in the number of adult butterflies occurs in late March or April. Some stray specimens emerge earlier in winter and early summer, these probably perish without breeding. In the deciduous forests, March–April is the time when the larval host plants produce a fresh flush of leaves. The females patrol looking for host plants that have a good amount of fresh leaves which are not yet occupied by eggs. However, occasionally they lay eggs on very small saplings with only 3–4 leaves. This probably

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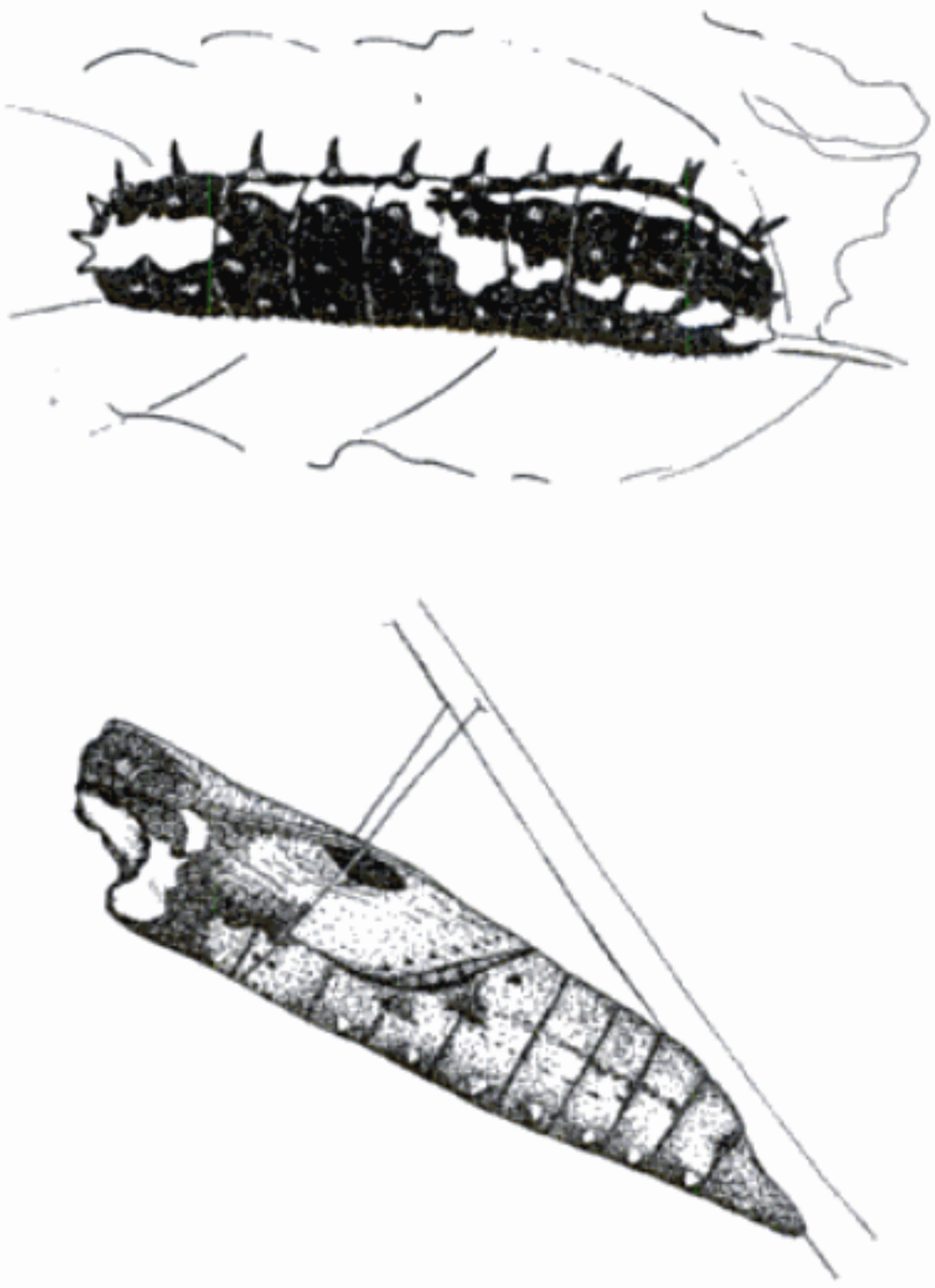
occurs as a consequence of intense competition for fresh leaves. The female lays eggs anywhere on the fresh leaves and many eggs may be laid on the same plant. The egg is spherical, shiny and orange-yellow.

The caterpillar rests on the upper surface of the leaf. It is velvety black or dark green in colour. The older caterpillar has dark red-brown longitudinal bands and red spots. A dorsal row of large, irregular, creamy patches is prominent. The osmeterium is light-blue in colour.



Length of caterpillar: 55 mm. Length of pupa: 38 mm.

The pupa is unique, exhibiting one of the most remarkable instances of protective resemblance in the animal world. It looks like a dead twig, about an inch long, broken off irregularly at the tip. The last segment is so modified that it appears as if it had grown out from the branch. The pupa is faint pinkish-brown, streaked and blotched with black and dark brown all over the surface. It is rough and tubercled on the abdominal segments.

Larval Host Plants The host plants are members of the family Lauraceae: *Alseodaphne semicarpifolia, Cinnamomum camphora, C. macrocarpum, Litsea chinensis* and *L. deccanensis*. *Cinnamomum* and *Alseodaphne* are more commonly used in the Western Ghats, and *Litsea chinensis* in the Himalayan foothills.

Suggestions for Student Projects The relative frequency of the two adult forms may change in different areas. Estimate this in the local population to check the probable variation in the proportion, according to the geographical areas and habitats.

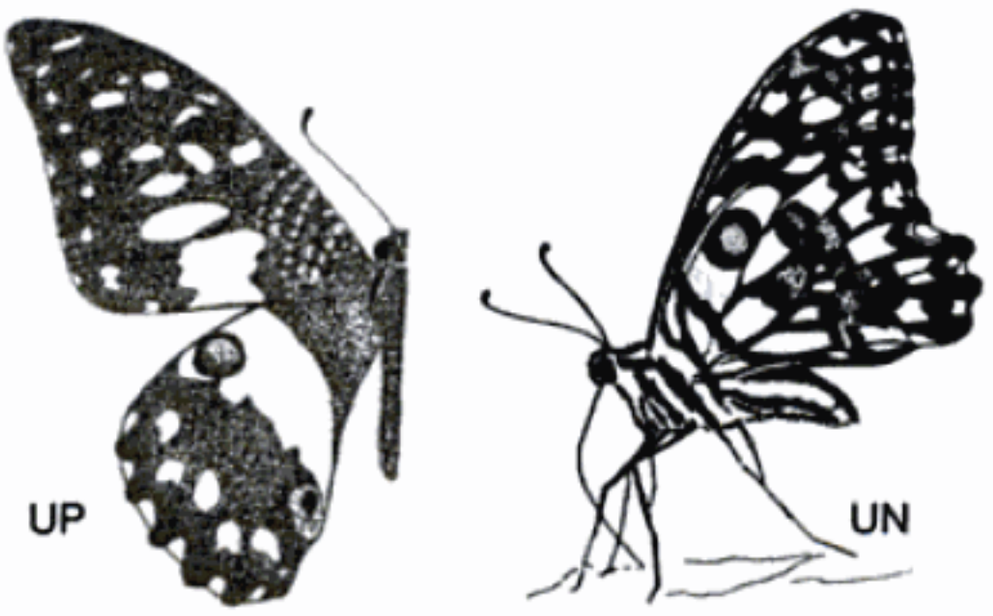
Contributed by *E Kunhikrishnan and Krushnamegh Kunte*

9. Lime Butterfly

(Plate 9, no. 52)

Scientific Name *Papilio demoleus* Linnaeus

Field Characters Wingspan: 80–100 mm. It is a medium-sized Swallowtail with black wings that turn brownish in old specimens. The wings are spotted with various shades of yellow. On the underside, it has a beautiful pattern in lemon yellow, red and blue. The abdomen is lemon-yellow with longitudinal black lines. The male and female are similar.



Large, black with yellow spots

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The species lacks the characteristic tails of Swallowtails.

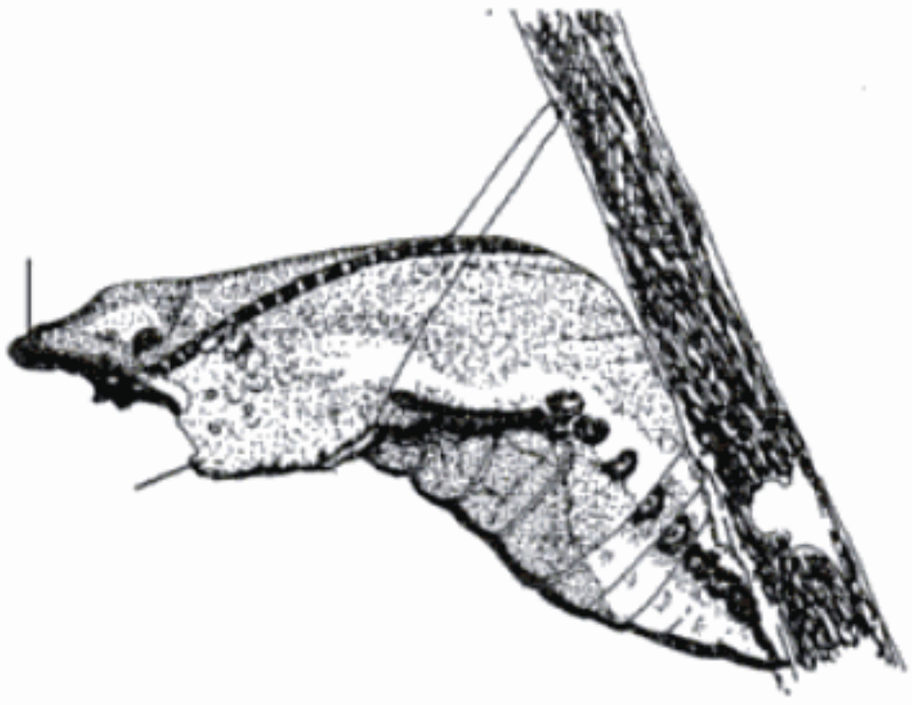
Status, Distribution and Habitat This species is perhaps found in more diverse habitats than any other Swallowtail. Its habitats range from savannahs, fallow lands and gardens to semi-evergreen and evergreen forests and it is particularly plentiful along streams and river-banks. It occurs throughout the year, but more commonly during the monsoon and post-monsoon months. It is distributed throughout south and southeast Asia and is common everywhere.

Habit This butterfly flies in several manners. In the morning it flies somewhat slowly ('slow' for an unprotected Swallowtail). During hotter hours it flies rapidly in search of a pool where sometimes many individuals congregate *en masse*. It flutters its wings for some time after settling on the soil, but finally sits motionless provided it is left undisturbed. Apart from mud-puddling, it is also an avid nectar-feeder. It prefers the flowers of tiny herbs to those of huge thickets, such as of *Lantana*. In the usual manner of Swallowtails, it visits the flowers only for a short while, and in haste. It is lured into gardens by flowers, in addition to cultivated *Citrus* plants on which its caterpillars feed.

This Swallowtail is unusual in that it basks in very open places with its wings spread flat; other species would do so in the forest, in the shade close to small openings. For basking, it prefers to settle on grass-tufts, small herbs, etc. at the height of 1 m or less from the ground. This is usually done on cloudy days. While resting, the wings are closed over the back and the fore wings are drawn between the hind wings.

Reproduction The female lays a single egg on top of a leaf and goes to the next plant or branch to lay its next egg. It unsteadily holds the leaf with its legs, hurriedly lays an egg and takes off shortly afterwards. The egg is light-yellowish and spherical. The caterpillar that hatches stays in the middle of the upperside of the leaf. It is oily-looking during the early instars, shaped like a bird's dropping and with similar colouration. Its colour is yellowish olive-green with a white spiracular band. There is also a white oblique band on the 8th and 9th segments, which looks like a white patch of uric acid deposition in a bird's dropping. Since it mimics birddroppings, it stays in moderately open places. However, in the later instars it turns uniformly pale green with a white sub-spiracular band along with a brown and white band on the 8th and 9th segments. An additional black band on the 4th and 5th segments develops, which has two black and two bluish eye-spots on it. At this stage the caterpillar lives in a secluded place, as it loses the protection gained earlier by mimicking a bird dropping. In spite of this, the parasitic wasps find a few of these caterpillars and lay dozens of eggs in them. The parasitic larvae eat the caterpillar from inside, finally destroying its vital organs.

The pupa is light green and unmarked. It has two projections in front of the head and one on the thorax. The pupa, when situated among dry objects, may be light grey-brown and heavily marked with dark brown and black streaks. It resembles the pupa of the Common Mormon (see that species for the distinguishing characters).



Length of caterpillar: 33 mm. Length of pupa: 30 mm.

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Larval Host Plants In different habitats it uses different host plants, all to of the family Rutaceae. In kitchen gardens and orchards it feeds on lime, lemon, etc. *Citrus* varieties: *C. aurantifolia, C. grandis, C. limon, C. sinensis* and also *Murraya koenigii*; in the forests on *Aegle marmelos, Atalatia racemosa, Chloroxylon swietenia, Glycosmis arborea* and *Murraya*; and on *Ruta* in fields and near water bodies.

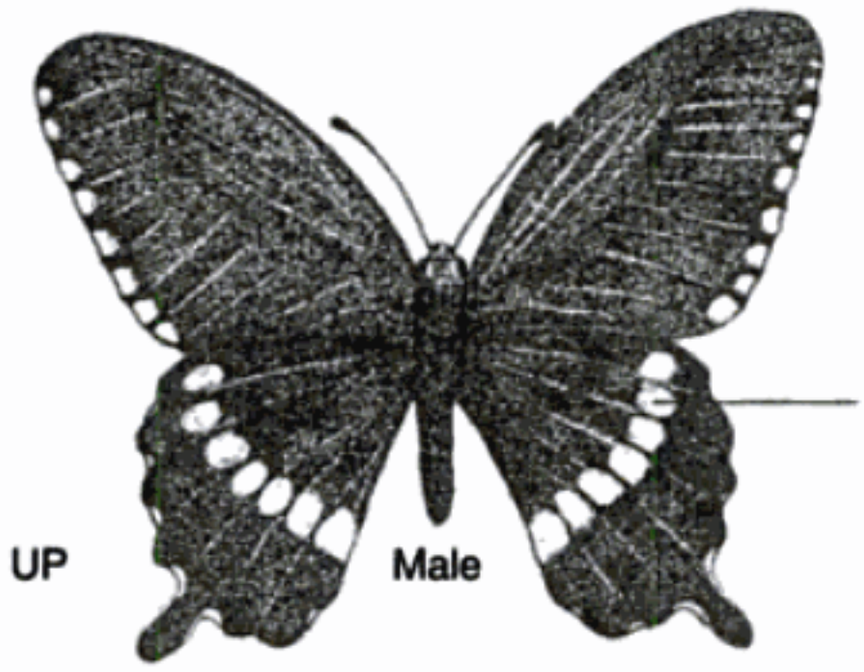
Economic Significance In places where *Citrus* varieties are extensively cultivated, it feeds exclusively on the crop plants and therefore is considered a pest. Sometimes it can pose a serious problem to the entire orchard because, when the caterpillars occur in high densities, they may devour a considerable proportion of the leaves and hence affect the production of fruits.

10. Common Mormon

(Plate 9, no. 53, Plate 8, no. 45 & 47)

Scientific Names *Papilio polytes* Linnaeus

Field Characters Wingspan 90–100 mm. The male is jet-black with a row of white spots along the central region of the hind wing. The margin of the fore wing also has a series of smaller white spots. The female has three forms. The form *cyrus* resembles the male in colouration with some indistinct red spots on the hind wing. The forms *stichius* and *romulus* mimic the Common Rose and the Crimson Rose, respectively, but have black bodies (Roses have a crimson body). The form *stichius* is a good mimic, but *romulus* is dull in colour and therefore less impressive in general appearance than its model—the Crimson Rose. The males are smaller in size.



Large, black with white spots

Female, form *romulus*.
Mimics Crimson Rose.

Female, form *stichius*.
Mimics Common Rose.

Large, black with white and red markings and black body.

Similar Species Female forms *stichius* and *romulus* of the Common Mormon look similar to the Common Rose and Crimson Rose, which they mimic (see above and those species, for details). The female of the Red Helen (*Papilio helenus* Linnaeus), resembles the Common Rose and therefore resembles the *stichius* form as well, but is larger. The male (Plate 9, no. 54) of this species is jet black with a large, lemon yellow spot at the upper edge of the hind wing. It is very large (wingspan 110–130 mm) and inhabits only riparian moist deciduous, semi-evergreen and evergreen forest tracts.

The Malabar Banded Swallowtail (*Papilio liomedon* Moore) has similar markings to the male of the Common Mormon. However, it

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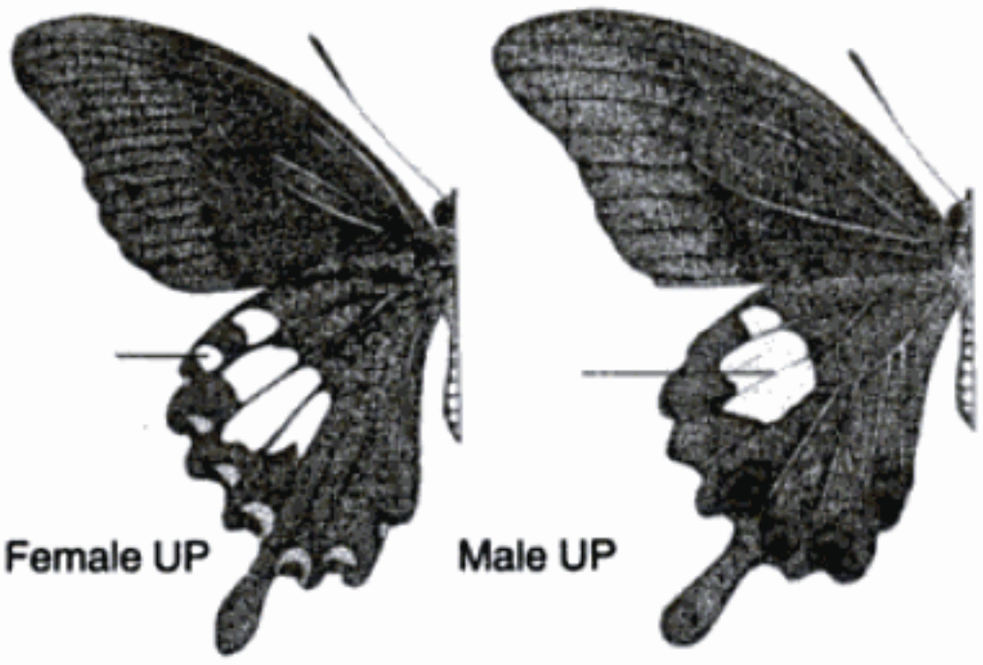
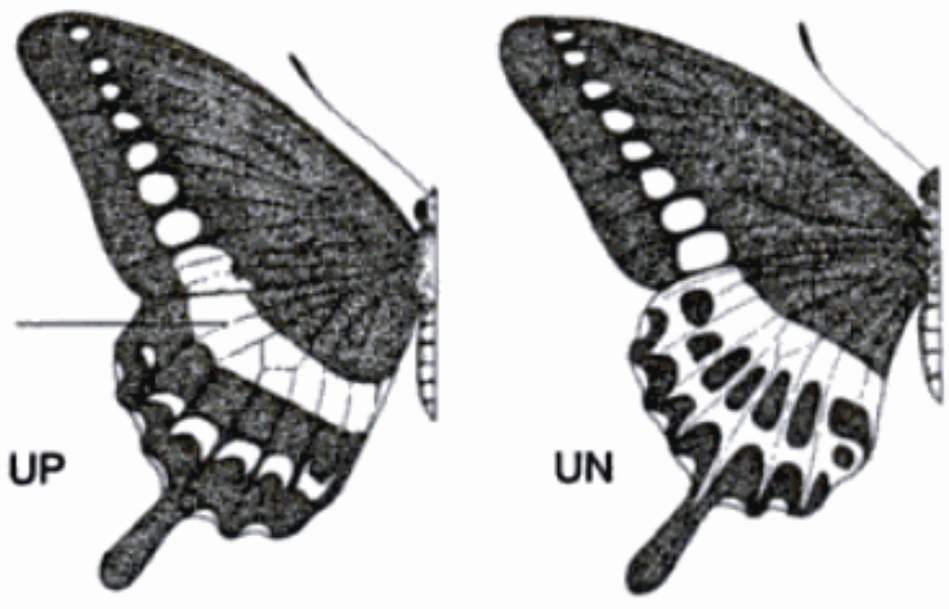


Red Helen



Malabar Banded Swallowtail

is slightly larger in size, a more powerful flier and has an additional band of yellow spots on the fore wings. It is endemic to the Western Ghats and an inhabitant of semi-evergreen and evergreen forests.

Status, Distribution and Habitat The Common Mormon, like the Tailed Jay, might have been a strict forest-dweller once upon a time. Now throughout India it is found commonly around human habitations as well. It inhabits home gardens and other well-wooded areas around habitations, deciduous forests and edges and openings in the semi-evergreen and evergreen forests. It is most common in the monsoon and immediate post-monsoon, but active throughout the year. It occurs throughout the Oriental region.

Habits Although it is common around human habitations, the Common Mormon is usually overlooked. Nonetheless, it is an interesting butterfly. The female forms present a good example of mimicry of the Roses in colouration as well as in habit. They copy the slow, fluttering flight of their models but do not fly as high up in the air as their models sometimes do. Moreover, they are less patient and, unlike their models, start flying faster and more erratically on the slightest disturbance. In spite of this, they are convincing mimics and it is sometimes essential to check the colour of the body to distinguish between the species. The male flies in the usual manner of Black-bodied Swallowtails—zigzag but unidirectional and with moderate speed. Both the sexes fly long distances at a stretch and seem untiring, as they are never seen resting during the day after they finish basking.

The Common Mormon feeds on nectar and also visits wet patches of soil. Due to its large size and long proboscis, it can feed from flowers with long corolla tubes. Around human habitations its favourite nectar sources are flowers of *Lantana, Jatropha, Mussaenda* and *Ixora*, but in the forests it feeds from *Asystasia, Peristrophe, Jasminum,* etc. along with *Mussaenda* and *Ixora*. Like the Blue Mormon, it remains close to the ground and never rises above 3 m while flying.

Only the males gather at wet soil patches. They may join mud-puddling assemblages of other species, but also form their own groups that may consist of several dozen individuals. Like the Red Helen, the males of this species prefer cool shaded places to open ones, for mud-puddling.

Both the sexes bask in the sun with their wings spread flat against the substratum. For this purpose, they usually sit close to the ground, on shrubs or tall herbs and lower their fore wings to cover a part of their hind wings.

Reproduction The male courts the female, which perches on an exposed branch with its wings open or closed, by flying slowly and elegantly behind it.

The eggs, which are round and yellow or light orange, are laid singly on the upperside of the leaves. The early instars of the caterpillar are similar in colouration and behaviour to that of the Lime Butterfly. It later becomes velvety dark-green in colour. A black transverse

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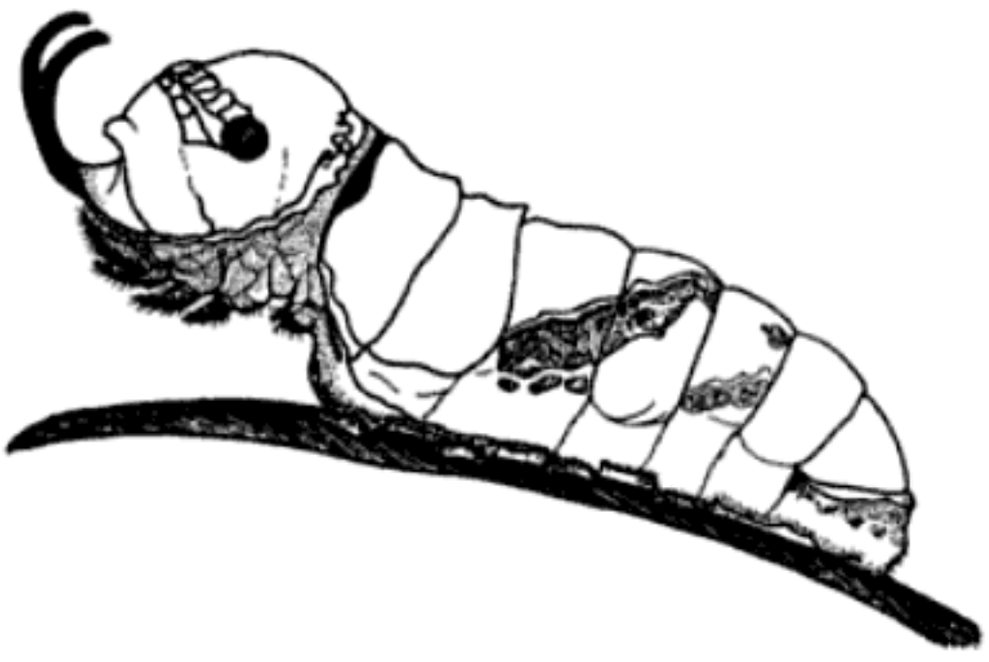
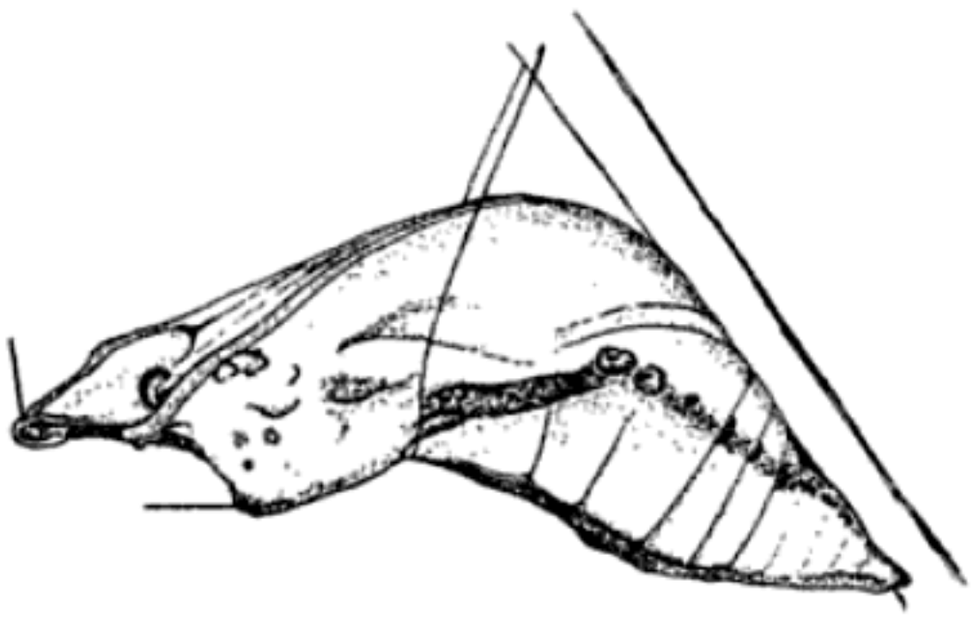
band with two eye-spots (one on each side) is present on 4th and 5th segments. This band is much darker and brighter than the one in the Lime Butterfly caterpillar. A black and white oblique band is present on the 8th and 9th segments. In general appearance and colouration, the caterpillar looks very similar to that of the Blue Mormon. It has a deep red osmeterium and yellowish-brown head (the Blue Mormon caterpillar has a green head).

The pupa is located on the underside of a twig or a leaf. The shape is similar to that of the Lime Butterfly and the Blue Mormon. It is grass-green when in the lush settings and grey-brown with darker grey, brown and black streaks when situated in dried vegetation. It differs from the Lime Butterfly in the following ways: 1) the projections on the head are separated by a deeper cut and 2) the abdomen is more protruded on the side, with a small point.



Caterpillar with osmeterium exserted



Length of caterpillar: 40 mm. Length of pupa: 31 mm.

The Chalcidoid wasps parasitize the caterpillar. Over a hundred wasps may emerge from a single Mormon pupa.

Larval Host Plants The caterpillars eat a wide variety of plants of many genera, but they are all either large shrubs or small trees, and of the family Rutaceae: *Atalantia racemosa, Aegle marmelos, Citrus aurantifolia, C. grandis, C. limon, C. medica, C. sinensis, Glycosmis arborea, M. koenigii, Murraya paniculata, Tripahsia* sp. and *Zanthoxylum rhetsa*.

Suggestions for Student Projects Mimicry and genetics in this species have been well studied (see Clarke and Sheppard 1972, Fryer 1913 and Larsen 1987). There is considerable regional variation in proportion of the three female forms in the Common Mormon populations and the variation adjusts in proportion to the presence and abundance of the models available (see section 2k. Adaptations to Escape Threats, Mimicry Among Peninsular Indian Butterflies). Since the seasonal occurrence of both, the model Roses and mimic Mormon, is likely to be different in different regions, it will be important to see whether there is regional synchronization also in seasonal occurrence and abundance. It is expected that there will be seasonal variation in the occurrence and abundance of the Mormon, so that local pattern matches that of the Roses. This can be tested by sampling seasonal occurrences of the Roses and the Mormon and studying the degree of overlap between them.

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11. Blue Mormon

(Plate 10, no. 55)

Scientific Name *Papilio polymnestor* Cramer

Field Characters Wingspan: 120–150 mm. This is a very large, black butterfly with glistening pale blue markings. On the underside, it is completely black with a red spot at the base of its wings and a few pale markings. Sometimes in the females a red spot of comparable size and shape is also found at the base of the fore wings on the upperside. The thorax and abdomen are black.

Very large, black, with blue hind wings

Status, Distribution and Habitat The Blue Mormon is most common in forests that receive heavy rainfall, due to which evergreen vegetation is predominant. It occurs also in riparian, moist deciduous forests and even in wooded urban areas (the latter seems to be a recent attempt at colonizing areas where its larval host plants, the *Citrus* spp., are cultivated). It is more common in late monsoon and immediately after it, though it occurs throughout the year. It is endemic to Sri Lanka and peninsular India.

Habits The best places to look for the Blue Mormon are forest paths and along streams. The male avoids the shade and flies in sunny patches to look for flowers, such as *Mussaenda frondosa*, *Ixora coccinia*, *Jasminum* spp., *Asystasia gangetica*, etc. which have long corolla tubes and large nectar reserves. It also comes to wet soil patches and there, while drinking, it keeps flapping its wings. Once settled on damp soil, rich in moisture and minerals, it does not get dissuaded easily by other butterflies or human presence and hence, is easy to approach. Torben Larsen reports that it is very fond of otter droppings.

Usually the female keeps to the shade and dense forest cover and therefore out of sight, so that it is less frequently encountered by human observers. The male has to search for a female and for this purpose it makes trips into thicker forests along nullahs and forest edges. Here *Atalatia*, its larval host, is more common. I have once seen three males courting a female that was lying dead on a rock in a forest stream. The female's abdomen had been ripped open in some places, probably by ants, revealing the wrinkled eggs inside. It had already been dead for a few hours!

The Blue Mormon seldom flies higher than 5 m from the ground and its flight is rapid. Although unidirectional, its flight is full of ups and downs and sideward hops. Therefore even when it is flying slowly, it is difficult to catch due to its dodging manner.

Occasionally it basks along shady roadsides and forest edges with its wings spread flat, but in such a way that most of the blue scaling on its hind wings is concealed by the fore wings.

Reproduction The courtship behaviour of the Blue Mormon is very similar to that of

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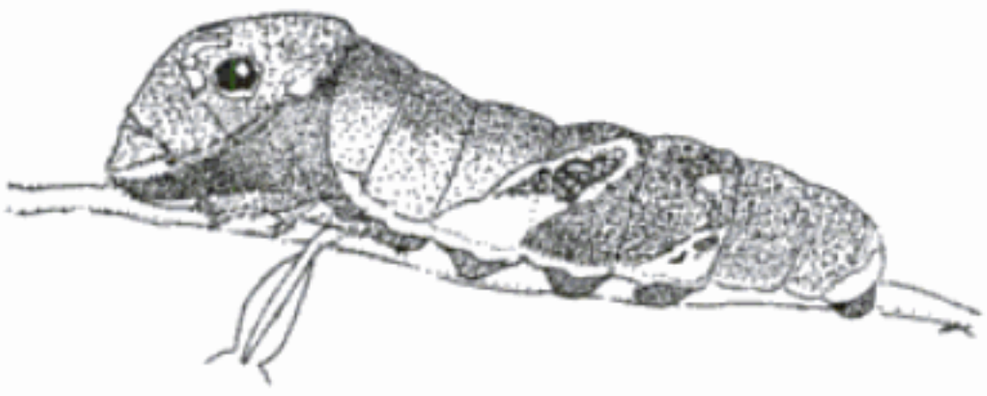
the Common Mormon. The eggs are laid singly on the upper surfaces of the leaves on rutaceous plants. The egg is spherical. It is light green when fresh, later turning orange-yellow. The little caterpillar mimics a bird-dropping with its olive-green body and whitish 'uric-acid' markings. The body is shiny and therefore more effective in making it look like fresh droppings. It rests in the centre of the leaf and nibbles at the edges. By the time it attains its green coat in the last two instars, it grows so big that it looks prominent on a leaf. At this time it stays on the underside of petioles and on twigs. It visits leaves only to feed. It walks haltingly and at each halt weaves silk on the substratum to keep a strong hold on it. Its colouration and markings are almost identical to that of the Common Mormon, but for a bright blue streak in the eye-spot on the segments 4–5 and a greenish head. The osmeterium is deep red. It is, of course, much larger in size at a comparable stage. The pupa is also similar to that of the Common Mormon but can be easily distinguished by the prominent folds on the lower side of the abdominal protrusion.



Length of caterpillar: 75 mm. Length of pupa: 40 mm.

Larval Host Plants The caterpillars feed on small rutaceous forest trees and large shrubs: *Atalantia racemosa, A. wightii, Glycosmis arborea, Paramigyna monophylla. Citrus grandis, C. limon* and other cultivated *Citrus* spp. are also utilized when they are available.

12. Paris Peacock

(Plate 10, no. 56)

Scientific Name *Papilio paris* Linnaeus

Field Characters Wingspan: 90–140 mm. The upperside is black, dusted with green. The fore wing is marked with a narrow, short, green central band, which may be absent. The hind wing has a large metallic blue patch that changes shades, a crimson tornal spot and three submarginal green crescent-shaped spots. The underside of its wings is dark brown. The fore wing has a broad grey band and the hind wing a series of marginal bright crimson spots. The female is similar to the male.

Large, black with a brilliant blue spot on the hind wing upperside

Similar Species The Common Banded Peacock (*Papilio crino* Fabricius) is smaller and has a bluish green discal band on both its wings. Its tail-tip is metallic green.

Status, Distribution and Habitat The Paris Peacock is a butterfly of the thickly wooded country at low and middle elevations, being particularly common in the short and tall, primary and secondary evergreen forests. It frequents forest streams. It is more common during the southwest monsoon months, but individuals appear throughout the year. It is found in the Western Ghats, along the

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Himalayan foothills and in northeastern India, also from northeastern Andhra Pradesh to southern Bihar. The global distribution extends over the Oriental region.

Habits It is among the finest of butterflies and the largest of the Peacocks. Both sexes visit damp patches, sometimes settling with their wings held flat against the substratum, hiding the brilliant blue patches on the hind wings.

It also visits flowers, especially *Lantana*, and the sight of a dozen butterflies or so hovering over the flowers is a rare treat to watch. The butterfly is restless while feeding and keeps flapping its wings.

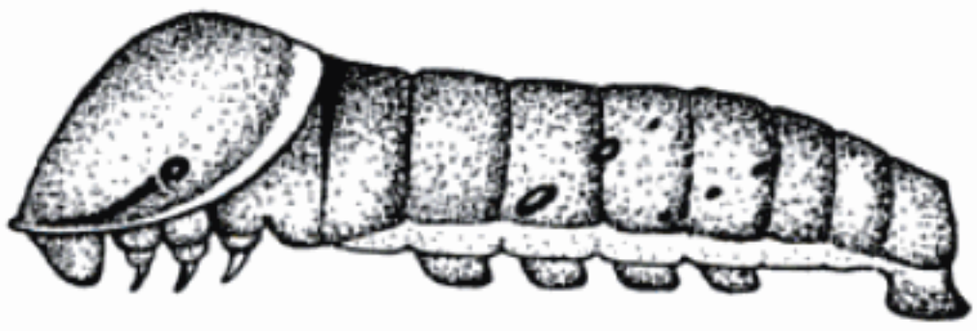
It has a swift, dodging flight with rapid wing-beats. The males maintain up-and-down beats along a forest stream. Thus, they return repeatedly to the same areas.

Reproduction The eggs are laid singly on the leaves. These are shiny, spherical and superficially pitted. Freshly-laid eggs are translucent green in colour and turn reddish-brown before hatching.

The young caterpillar is dark olive-green with brown and white markings. The grown-up is bright grassy-green with yellow and white spots, a lateral white band from segments 5–6 to the anal end and a faint diagonal line.

Just before pupation, the caterpillar climbs higher up on the tree and pupates among the foliage. The pupa is green with yellowish-green wing-cases, a broad dorsal yellow band from the cremaster to segments 4 and 5, which continues as a pinkish-brown line to segment 2. The pupa yields a butterfly after about 25 days.

The eggs are prone to attacks by Ichneumonid wasps and up to 90% may be destroyed by parasitoids.



Length of caterpillar: 50 mm. Length of pupa: 40 mm.

Larval Host Plants The caterpillars feed on plants belonging to the family Rutaceae, which include *Citrus* sp., *Evodia roxburghiana*, *Toddalia asiatica* and *Zanthoxylum ovalifolium*.

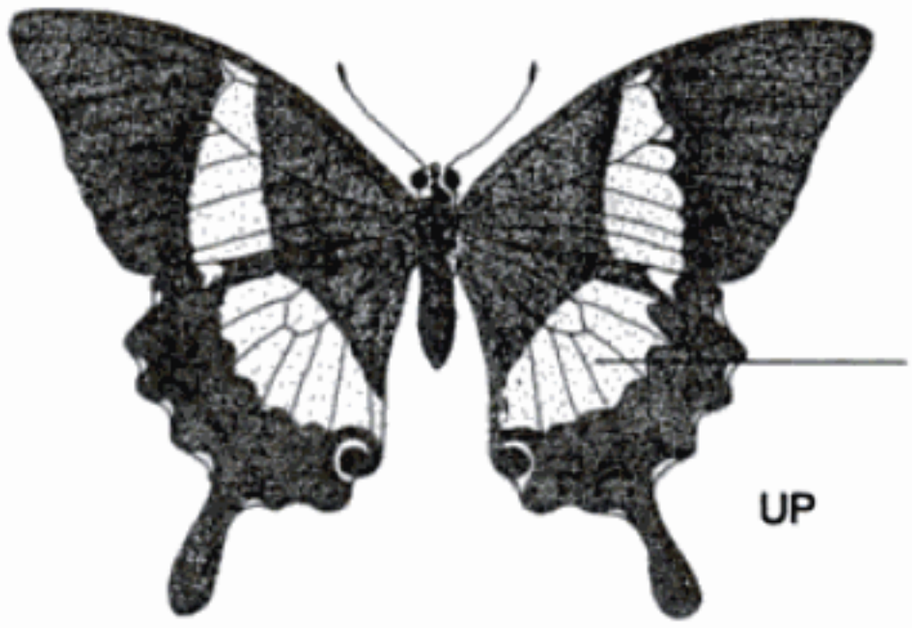
Contributed by *K Gunathilagaraj.*

13. Malabar Banded Peacock

(Plate 10, no. 57)

Scientific Name *Papilio buddha* Westwood

Field Characters Wingspan: 90–100 mm. This butterfly is black with a broad central band on the upperside. The colour of this band is variable (although it usually is shades of blue) and depending on the angle of light, it shows all shades between purple and blue and rich deep green to greenish-yellow, all of which are metallic. The blue band enters the cells of both its wings. However, the underside of the wings is black without a trace



Large, black with a broad metallic blue-green band

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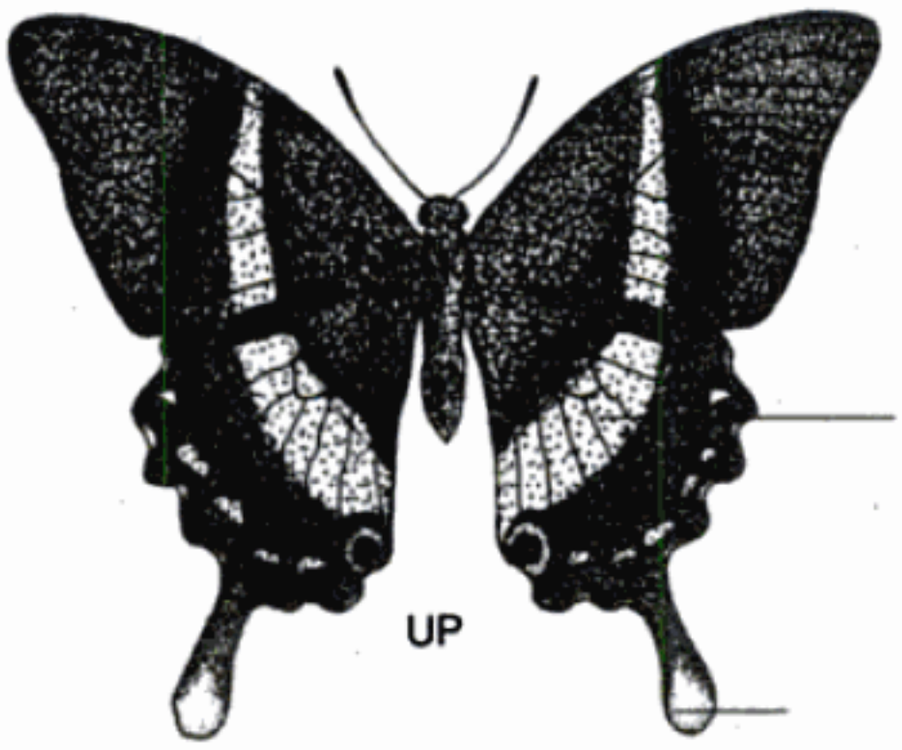
of blue scaling. The sexes are similar in colouration.

Similar Species The Common Banded Peacock and Paris Peacock are similar. The former is less bright and its tail-tips are green (black, in the case of the Malabar Banded Peacock). It is found in dry deciduous and thorn forests. The Paris Peacock is larger and its greenish-blue patch is restricted to the hind wings.



Common Banded Peacock

Status, Distribution and Habitat The species is endemic to the Western Ghats and relatively more common between southern Goa and northern Kerala. This is an uncommon but locally abundant butterfly. It is restricted mainly to the lowland evergreen and semi-evergreen forests that lie close to the sea coast. However, it also occurs in secondary forests and home estates that are common south of Karnataka. It is active during the monsoon and post-monsoon months.

Habits The Malabar Banded Peacock is perhaps the most beautiful butterfly in peninsular India and one of the most dazzling in the world. However, it is difficult to observe its brilliant colours since it flies among the tree-tops, showing only its dark underside to the observers on the ground. On rare occasions it does come down to shrubs to feast on nectar or to have a sip from wet soil near a forest stream. *Lantana* and *Clerodendrum paniculatum* are two shrubs that greatly attract it and since these are common around human habitations, it often ventures into gardens neighbouring the forests. According to Torben Larsen, 'there are no records from damp patches' but I have seen it mud-puddling, though rarely and only momentarily.

It is most active during the noon and afternoon, flies fast and straight and is difficult to observe for long periods because it soon vanishes amid the tree-crowns. Apart from being a swift flier, it can easily and rapidly avoid obstacles and therefore flies fast even in the dense canopy.

The males engage themselves in 'hill-topping', that is, they fly along ridges or other relatively open forest patches to make trips to and from the valleys and hill-tops in search of females. The females are rarely seen and they probably spend most of their time in denser forests. However, they form 50% of the population, as estimated by Bell after rearing the caterpillars.

Reproduction The egg is laid on a tender shoot or on the upperside of a mature leaf. It is spherical, slightly shiny, rough, plain lemon-yellow when laid, but later develops a rusty-brown band at the equator with a darker line in the centre of the band. A similar rusty-brown blotch is visible at the top of the egg. The young caterpillar feeds on fully expanded but tender leaves. It is greenish-yellow with olive-green dorsal and lateral bands. In later instars it develops an irregular white spiracular line and yellow blotches and spots all over the body. In the final instar it becomes dull and smooth in complexion. It is then dark-green with a sub-spiracular yellow band and yellow spots all over the body. A transverse series of yellow spots are present on the 4th and 5th segments. Those on the 4th segment end in a distinct or indistinct eye-spot. The osmeterium is reddish. The leaves of its larval host plant, *Zanthoxylum rhetsa*, are often marked with yellow specks caused due to internal infections. The green caterpillar speckled with yellow easily camouflages itself on such leaves.

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The caterpillar does not wander much in search of a safe place and therefore the pupa is made on the underside of a leaf or twig usually on the host plant itself. The pupa is dark green with a black spot on the 6th segment. There are conical projections in front of the eyes. The thorax is humped. The dorsal and lateral lines on the body and yellow lines on the lower wing-margins are also visible.

Its larval host plant is a deciduous tree and grows leaves just before the monsoon. The adults appear at the beginning of the monsoon when there are leaves on the host plant. However, this species produces probably o nly one brood per year, so the resultant pupae of this new generation remain dormant for a few months, until the onset of the monsoon the next year.

Length of caterpillar: 46 mm. Length of pupa: 32 mm.

Larval Host Plants The caterpillars feed on a large tree: *Zanthoxylum rhetsa* (Rutaceae), which grows in the moist deciduous and semi-evergreen forests, fringes of evergreen forests as well as home estates in the Western Ghats, especially at low elevations.

Economic Significance In a test conducted by Wynter-Blyth to decide which of the Indian butterflies was most beautiful, the Malabar Banded Peacock stood third. However, it could have taken the first place that was occupied by similar-looking "Blue Peacocks" (which includes the Common Peacock, *Papilio polyctor* Boisduval and Paris Peacock). This species is among the most favourite of the butterfly collectors and fresh, undamaged specimens may fetch a very high price in illegal markets.

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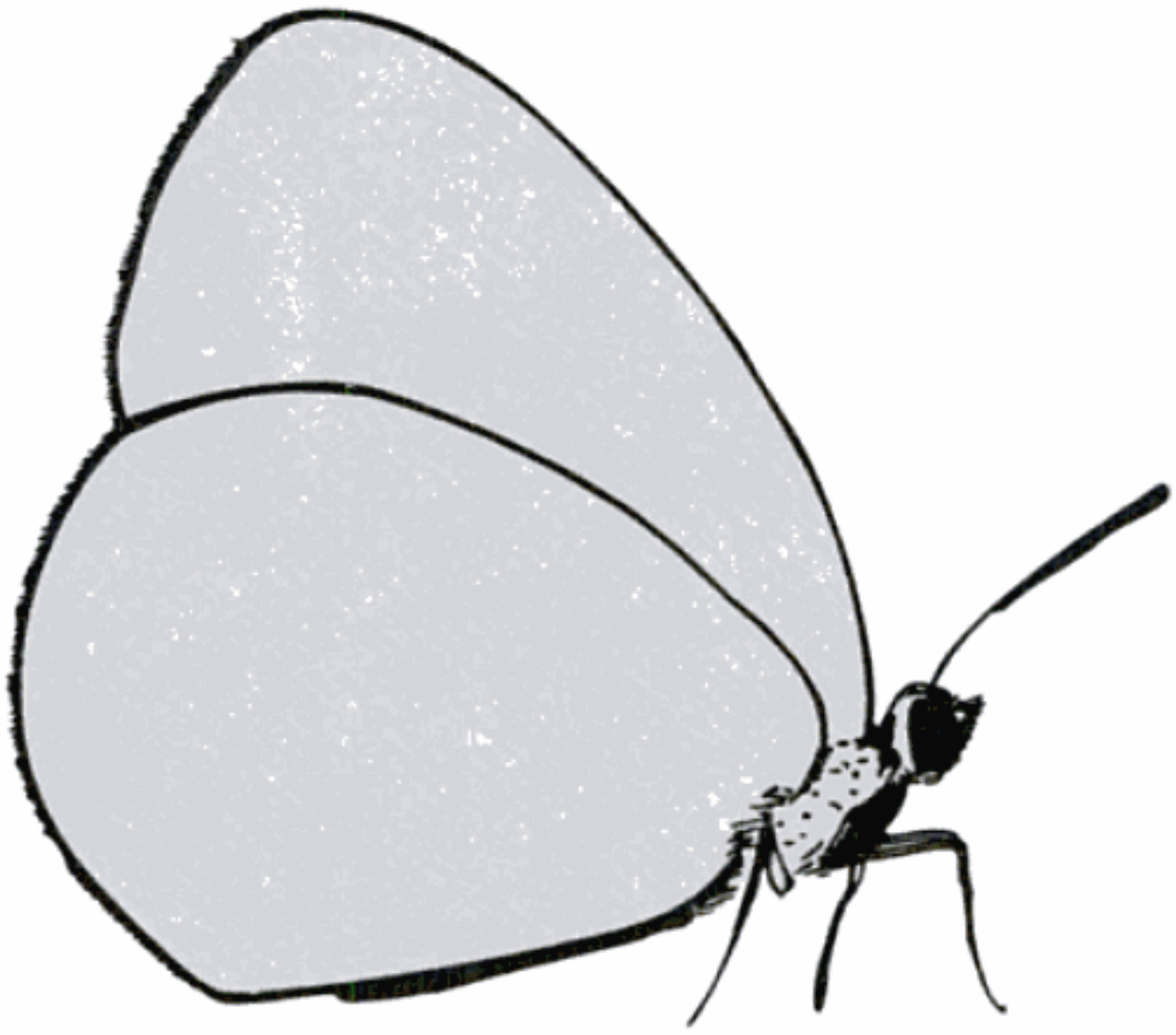

5.2 Family Pieridae

Whites and Yellows

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Family Pieridae

Family Pieridae has amongst its members some of the most familiar butterflies. In fact, the name "butterfly" (butter + fly), is derived from members of this family: the Brimstones, due to their yellow ("butter"-like) wing colour. All of us know these butterflies since our childhood days when we ran after the Grass Yellows: small, bright yellow butterflies that flutter close to the ground, and the Emigrants: large whitish-yellow butterflies, to catch and keep them as prized specimens or pets. These butterflies have a predominance of white and yellow, hence they are called "Whites and Yellows".

This family is among the smaller families of butterflies in India. There are 109 species recorded in India, which is only 7.26% of the entire Indian butterfly fauna. Over 35 species represent this family in peninsular India.

Whites and Yellows have slightly broad fore wings but the wing apex may be narrow and pointed. The hind wings are round and they are occasionally toothed. The inner margin of the hind wings forms a channel around the abdomen which covers it completely and hence the abdomen is never visible in the field when the butterfly rests with its wings closed. When it settles, the wings are always kept closed over its back. At rest, the Psyche, Orange Tips, Arabs and Albatrosses almost completely draw their fore wings between the hind wings. They bask in the sun but most of them do so with their wings closed, unlike most of the butterflies from other families.

All their six legs are perfect. The labial palpi are short and close to the face, not very large or projecting as in Blues and Brush-footed butterflies, nor as hairy as in Skippers. The compound eyes are pale yellow, faint bluish or greyish, spotted black. The thorax is of a medium size and the abdomen is usually long and narrow, except in fast fliers such as the Great Orange Tip and Emigrants, which have a robust thorax and a relatively short abdomen.

The males usually have distinct secondary sexual characters, such as hair pencils and brands on the wings, which are easily visible if the specimen is in one's hand. The males are brighter and their markings narrower. The females are dull, heavily marked and usually larger in size.

Whites and Yellows are found in all types of habitats ranging from arid grasslands with short and sparse vegetation to the thick, wet evergreen forests of the southern Western Ghats. However, in the evergreen montane forests they prefer openings and edges where sunlight is plentiful. The Arabs (genus *Colotis*) are inhabitants of dry open areas, Blackveins *(genus Aporia*) and Cabbage Whites abound on the slopes of the Himalayas (one species is found in the southern Western Ghats). The Emigrants and Grass Yellows are found in gardens, scrub and deciduous forests, the Lesser Gulls, Albatrosses and Puffins dwell in semi-evergreen and evergreen forests.

Despite this wide range of habitats used, most fly close to the ground at the level of the herbs and shrubs, where their choicest food, nectar, is most abundant. The exceptions are the Common Jezebel and Albatrosses which also fly among the treetops in the tallest forests. The nature of flight varies greatly among these butterflies. The Psyche and Grass Yellows flutter weakly, smaller Orange Tips and Gulls have moderate speed but Albatrosses, the Great Orange Tip and Emigrants are swift and dashing. The males inhabit more open areas, are fond of the sunshine and are very active. They sometimes assemble on wet soil patches in large numbers, especially during the summer. The females keep more to the shade, close to the larval host plants and are less active. Many species sleep on the upperside of herbs and low, pendant branches of shrubs and trees.

Whites and Yellows usually have distinct seasonal forms which vary in coloration and markings. The dry season forms are

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paler and their markings obscure. The wet season forms are bright and well-marked and usually larger. Some of the Grass Yellows have a brown blot on the underside of the fore wing in their dry season forms. The Spotless Grass Yellow has brown dustings and a long line on its underside in the dry season.

The eggs are spindle-shaped, tall and ribbed. They may be finely ornamented. They are white or pale yellow. Infertile eggs may turn reddish in colour. The eggs are usually laid singly on the fresh buds, but the Pioneer and Common Jezebel lay them in large batches of up to 200 and several dozen eggs, respectively. The caterpillars are cylindrical and of uniform girth from the second to the last segment. Their body and head are both covered with round, pointed tubercles which bear white hair. The caterpillars are dark leafy-green with few or no markings. They depend on camouflage and therefore rest during the day to evade detection. The full-grown caterpillars always sit on the upperside of leaves or twigs. The caterpillars of all species give out a green fluid from the mouth when disturbed and some species like the Emigrants even jump off the leaf. This fluid is unpleasant to the senses and may act as an insect repellent. Some species are heavily parasitized by Ichneumon and Chalcidoid wasps, against which no effective mechanism seems to have evolved among caterpillars. Before pupation, the caterpillars wander from the host plant in search of safe places and pupate in dense foliage or close to the ground where they are well-concealed. The pupae are suspended on the underside of the leaves or slanting twigs and supported by a silken body-band. The caterpillars of Gulls and Cabbage Whites pupate on the upperside of the leaves. The pupae may be angular and laterally flat, or roundish with flat backs. However, they always have a pointed or hooked projection in front of the head. A few projections may be present on the thorax. The pupae may have a loose body-band, or be tightly embraced by it. In the former case, it can move violently if touched, but in the latter, it can barely move.

Sometimes, species such as the Emigrants, Cabbage Whites and Common Albatrosses reproduce synchronously. Their populations explode, the caterpillars devour all the available host plants, and the adults which develop from these caterpillars are forced to migrate to other areas in search of host plants for their larvae. This leads to mass migration with hordes of individuals numbering up to millions flying as a single cloud and straddling an area of even a few square kilometers under them.

The subfamily-level classification of peninsular Indian Whites and Yellows is very simple with only two groups. However, these groups are somewhat arbitrary from the point of view of their members' physical appearance. The groups are classified as follows:

1. Subfamily Pierinae: It comprises the "Whites". Most members are predominantly white, but many are yellow as well. This group includes the Psyche, Jezebel, Sawtooth, Gulls, Pioneer, Albatrosses, Cabbage White, Orange Tips, Arabs and Wanderers. Their larval host plants belong to the families Loranthaceae (Common Jezebel), Euphorbiaceae (Albatrosses), Brassicaceae (Indian Cabbage White), Salvadoraceae (Small Salmon Arab) and Capparaceae (the rest of the group).

The Common Jezebel is the only unpalatable peninsular Indian species from this family. The Painted Sawtooth mimics the Jezebel. The female of the Common Wanderer mimics the Blue Tiger and the Glassy Tiger well.

Male, UP

Small Salmon Arab

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2. Subfamily Coliadinae: The "Yellows" contribute to this subfamily. They include Emigrants, Grass Yellows and the Clouded Yellow. Their larval hosts are plants of the families Caesalpiniaceae, Fabaceae (= Papilionaceae) and Mimosaceae.

14. Common Emigrant

(Plate 10, no. 58)

Scientific Name *Catopsilia pomona* Fabricius (Old: *C. pomona* Fabricius and *C. crocale* Cramer)

Field Characters Wingspan: 55–80 mm. This is one of the most variable butterfly species in India, as far as coloration and size of the adult are concerned. The colour of its wings ranges from white with only basal areas of the wings yellow of varying shades, to completely plain lemon yellow (hence another name—'Lemon Emigrant'). In forested regions, especially in the summer, the individuals are much larger and a brighter sulphur-yellow with brown blotches. Despite these variations, certain characters persist in all specimens. These are as follows: on the upperside, at least the bases of all the four wings are yellow, the front margin and apex of the fore wings are narrowly black in the male and broadly black in the female. In the female, this margin may converge to a spot at the cell-end. Apart from blotches or spots, if they are present, the underside is unmarked.

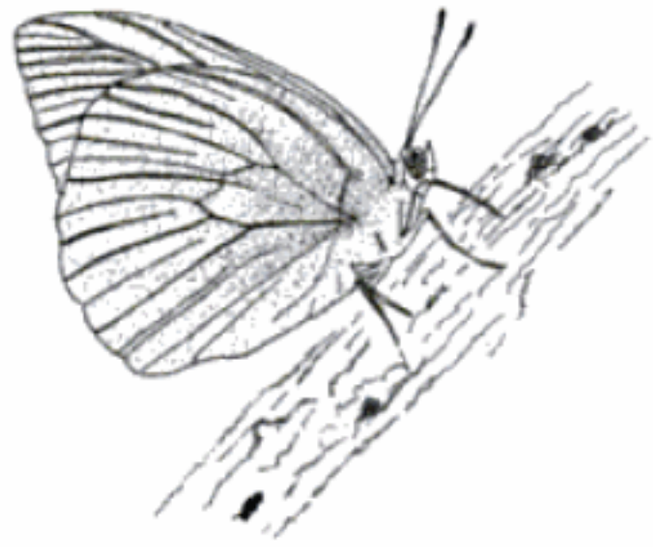
Similar Species The Mottled Emigrant is slightly smaller. The male is greenish while the female is yellow, and both have fine, dark grey or brownish striations on the underside of the wings. It has fewer colour and size variations.

Earlier, India was supposed to have four species of Emigrants: Common Emigrant

Female dry season form UN

Female UP

Medium-sized, white and yellow with black markings



Male UN

Male UP

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(*Catopsilia pomona* Fabricius), Lemon Emigrant (*Catopsilia crocale* Cramer), African Emigrant (*Catopsilia florella* Fabricius) and Mottled Emigrant (*Catopsilia pyranthe* Linnaeus). However, the breeding of these species revealed that the Common Emigrant and the Lemon Emigrant were the same species and so were the Mottled Emigrant and African Emigrant.

Status, Distribution and Habitat This butterfly is seen in all habitats, except wet evergreen forests and very high altitudes. Climatic, geographic and vegetational variations apparently have little effect on its distribution, since it adjusts to local conditions easily. However, it avoids very hot and dry areas, where the Mottled Emigrant is common. Its global distribution extends over all of south and southeast Asia and Australia.

It is common wherever it occurs and in all seasons too. However, it is more abundant during the monsoon and post-monsoon months, progressively becoming less common in the winter and early summer, again becoming numerous just before the onset of the monsoon. In the pre-monsoon months, most of its larval host plants produce fresh shoots, which boosts the larval as well as adult populations.

Habits In the mornings, this butterfly can be seen basking with its wings closed over the back and slightly tilted to face the sun. Once it is on the move, it is amongst the liveliest of butterflies. It flies in a powerful manner with erratic ups and downs and unpredictable jerks. It disperses efficiently to new areas and in places where annual fires are common, this is one of the first butterflies to frequent the burnt areas. It wanders in search of flowers, the omnipresent *Lantana* being the most sought-after species. While it is engaged in sipping nectar, one can often approach it very closely. In open areas it prefers the flowers of herbs, especially those of the "coat button" (*Tridax procumbens*).

Begining in the late afternoon, individuals slowly retire seeking the exposed uppersides of leaves on branches of shrubs and small trees, or grasses, where they sleep. This is among the first butterflies to retire at the onset of overcast conditions during the monsoons. During this time, however, it selects slightly secluded branches for resting.

In the dry months, the male Common Emigrants crowd forest water-holes for mud-puddling in swarms of hundreds and thousands. These mud-puddling sites are excellent galleries displaying the varied colours, forms and markings exhibited by the species. The members of these assemblages display habits similar to the Common Albatross, as described in the section on that species.

During the peak season, predators of the adults—spiders, birds and to some extent lizards, take a heavy toll on the flourishing population. The web-spinning spiders and the Bee-eaters are the most notorious among them, from whom there is rarely an escape.

Reproduction When a male approaches, the willing female sits on the ground or a leaf, its wings spread flat and the tip of its abdomen turned upwards. The male grabs the female's abdominal tip with its claspers and takes off. The female remains suspended upside down.

After fertilization, when the eggs are ready to be laid, the female chooses fresh leaves of various species of *Cassia*. The eggs are usually laid on the underside, at the margin of the leaves. Each white egg is bottle-shaped and ribbed vertically. The young caterpillar is yellowish-green. Later, it turns leafy green and develops a black longitudinal line which is paired with a white one on either side of the body. The head is green in colour. The caterpillar of the Mottled Emigrant is similar, but has a much broader black band on the sides, leaving only a narrow green band on the back. The surface of the caterpillar is tubercled, each tubercle bearing a minute hair, with a tiny droplet at its tip. If disturbed, the caterpillar exudes a green fluid from its mouth. The fluid is unpleasant to smell and may repel some insects. However, it does not deter the parasitoids.

Pupation takes place amidst dense foliage and close to the ground. The pupa is held by a silken body-band. It is bent on the back of the

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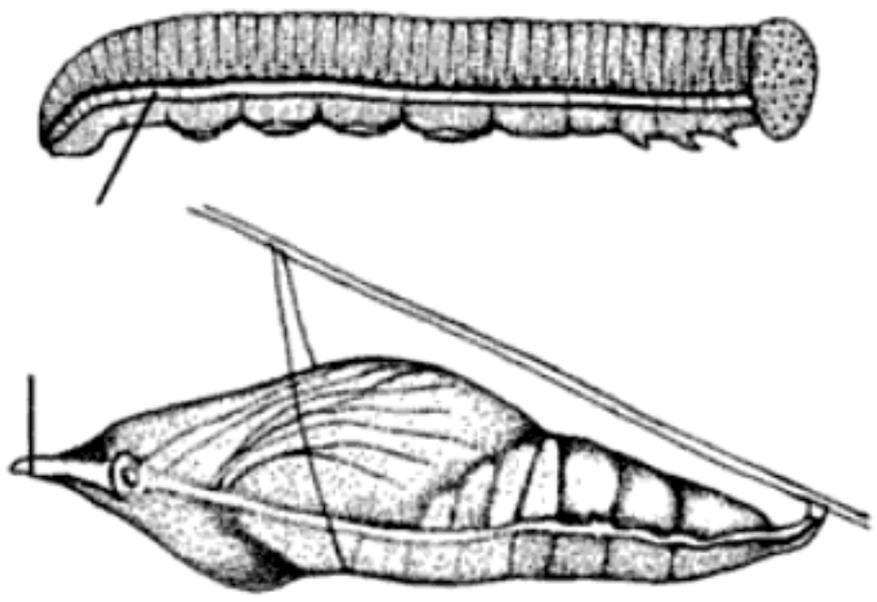
thorax and has an elongated and pointed projection in front of the head (this projection is shorter in the case of the Mottled Emigrant).

There is intense predation pressure on the larval population. Birds are significant among the vertebrate predators, but invertebrates, especially insects, pose a much more serious threat. Many kinds of wasps such as mason wasps, digger wasps, paper wasps, etc. store the Emigrant caterpillars in their nests to feed their larvae.



Length of caterpillar: 41 mm. Length of pupa: 28 mm.

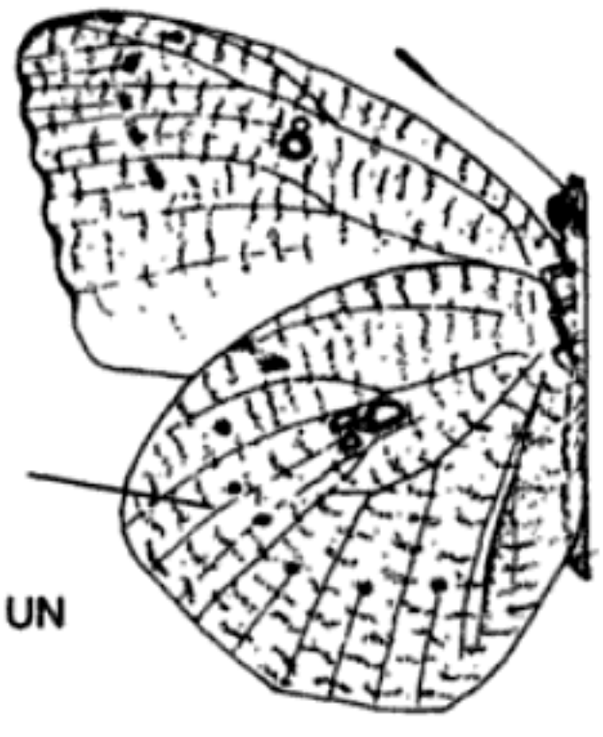
Larval Host Plants The caterpillars feed on various species of *Cassia*: *C. fistula, C. siamea* and *C. tora* (Caesalpiniaceae); the first two are more frequently used. *C. fistula* is a small tree, common in the deciduous forests and is also extensively planted along with the exotic *C. siamea*, near human habitations in gardens and as an avenue plant. Other recorded host plants include *Butea frondosa* and *Bauhinia racemosa* (Fabaceae and Caesalpiniaceae, respectively), which are also small trees found in the deciduous forests.

15. Mottled Emigrant

(Plate 10, no. 59)

Scientific Name *Catopsilia pyranthe* Linnaeus (Old: *C. pyranthe* Linnaeus and *C. florella* Fabricius)

Field Characters Wingspan 50–70 mm. The upperside is dull white and the underside is finely striated with light brown or dark grey. The male has a narrow black border at the apex of its wings as well as a small cell-end spot and its underside is tinged with faint green. The female has a broader black border and larger cell-end spot, its underside is tinged with yellow.



Medium-sized, white with faint striations

Similar Species The bases of the Common Emigrant's wings are yellow, especially on the upperside. Its wings are not striated.

Status, Distribution and Habitat This species replaces the Common Emigrant in semi-arid and arid areas with little woody vegetation, but both may co-occur in dry, wooded habitats. It is abundant in the Deccan plateau on cultivated land, scrub, grasslands and savannahs. It also inhabits the dry foothills at the base of the Western Ghats and other hill-ranges. It is active throughout the year, but most abundant during the pre-monsoon and post-monsoon months. It is distributed in tropical Africa, south Asia, southeast Asia and parts of Australia.

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Habits The Mottled Emigrant is an energetic butterfly which rarely rests during its activity period. It is most active during the morning and early afternoon, covering long distances in single flights. It flies close to the ground in a powerful and bounding manner similar to the Common Emigrant.

It feeds on the flowers of herbs and shrubs, for example, *Abutilon indicum, Boerhaavia diffusa, Caesalpinia coriaria, Cajanus cajan, Lantana camara, Medicago sativa, Momordica charantia, Punica granatum, Sesbania sesban, Sida cordifolia* and *Tagetes erecta.* On hot days the males gather in great numbers on wet soil, forming dense mud-puddling assemblages.

While resting, the wings are closed over the back but the fore wings are not drawn between the hind wings. This posture is maintained while basking also, but the butterfly usually leans on one side, so that the wing surface is perpendicular to the sun's rays.

Because this species forms large hordes of freshly emerged individuals, it is a regular migrant in the plains of peninsular India, travelling both long and short distances.

An interesting observation on the behaviour of male Mottled Emigrants towards a crab spider and a female Mottled Emigrant, was made in Pune during the monsoon. The spider had caught and killed a female Mottled Emigrant. A couple of male Mottled Emigrants unsuccessfully attempted to mate with the dead female, while the spider was still clutching it. Then another male landed on the female and tried sucking something from thorax of the female, but did not try to mate. All the while, the spider was trying to push away the male and have a peaceful meal! (See plate 2, no. 9).

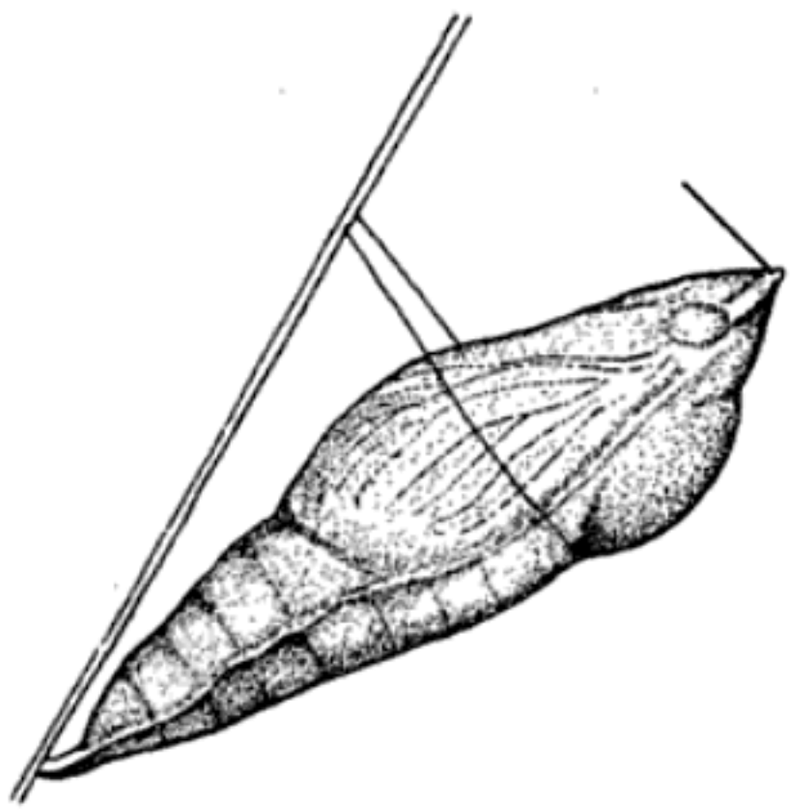
Reproduction Courting and mating behaviour in this species is similar to that of the Common Emigrant. The eggs are laid anywhere on fresh shoots and usually many eggs are laid on the same plant. The egg is spindle-shaped with 12 longitudinal ridges. The freshly-laid egg is white, later turning light pink.

The young caterpillar is yellowish-green, while the older caterpillar is glossy green with a light green head. The body is cylindrical. There is a spiracular thin white line and a very broad, black band on the side, which is adorned with small, glistening blue dots. The caterpillar feeds on any green part of the plant. Although fresh shoots are preferred, in their absence, it will feed on even the most mature leaves.

Pupation takes place near the ground and in a secluded place, so that the pupa is difficult to locate. It is green with a yellow line on the side. The head is produced into a short, pointed snout and the wing-cases are bulging.

The caterpillars are preyed upon by the predatory bugs: *Rhinocoris fuscipes* (Reduviidae) and the shield bugs: *Cantheconidia furcellate* and *Andrallus spinidens* (Pentatomidae).

Sometimes dozens of females lay hundreds of eggs on the same bush and on all the plants available in an area. Due to over-crowding on the plants and the intense competition for food, many caterpillars starve to death or pupate very early. In the process they may devour all the available leaves on the plants, thus forcing migration



Length of caterpillar: 40 mm. Length of pupa: 22 mm.

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on to themselves as soon as they emerge from the pupae.

Larval Host Plants The caterpillars feed on plants of the family Fabaceae (= Papilionaceae). The recorded species are *Cassia auriculata, C. fistula, C. tora, C. occidentalis* and *Sesbania bispinosa. Gnidia glauca* (Thymelaeaceae), is also reported from Bheemashankar (Maharashtra).

Economic Significance It is an occasional pest on *Sesbania* spp. and *Cassia* spp.

Contributed by *Krushnamegh Kunte and K Gunathilagaraj*

16. Common Grass Yellow

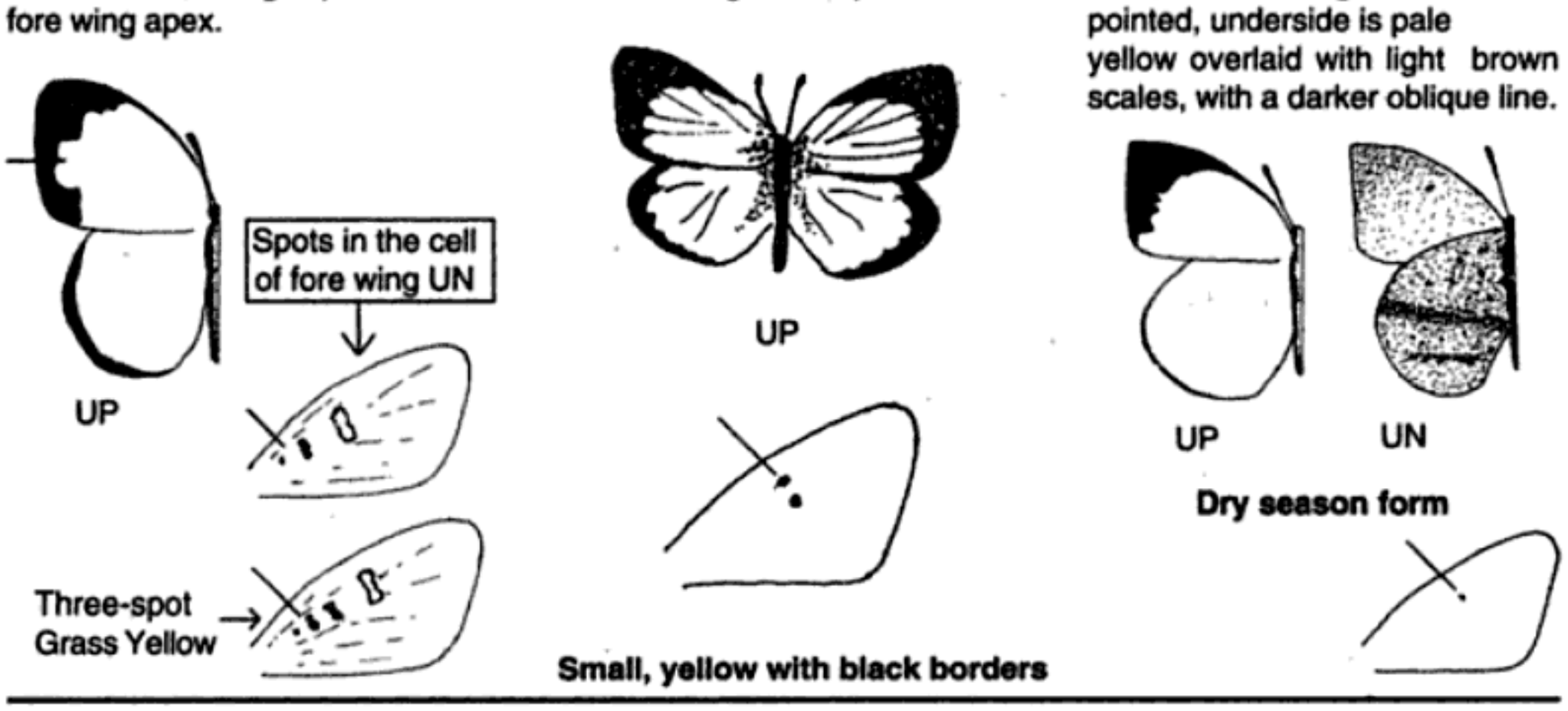
(Plate 10, no. 60)

Scientific Name *Eurema hecabe* Linnaeus
(Old: *Terias hecabe* Linnaeus)

Field Characters Wingspan: 40–50 mm. This is a bright yellow butterfly with black borders on the upperside of its wings. Two other species of Grass Yellow also occur commonly and widely. The key to their identification is the number of black spots in the cell on the underside of their fore wings. These spots may be observed by netting the butterflies in a manner which does not damage them, or even by approaching a resting butterfly close enough on the field. The wet season forms of all these species are yellow on the underside and brighter yellow with black borders on the upperside. Their dry season forms and markings are described in the table below.

Another species, the Three-spot Grass Yellow (*Eurema blanda* Boisduval), is rare in peninsular India, but locally common where it is found and is often the only Grass Yellow to occur in the wet evergreen

Common Grass Yellow	Small Grass Yellow	Spotless Grass Yellow
Eurema hecabe Linnaeus Wingspan: Large, 40–50 mm. Colour: Very bright yellow. Markings: Brown blotches on underside of fore wing in the dry season form, a large spot at each fore wing apex.	*Eurema brigitta* Cramer Wingspan: Smaller, 30–40 mm. Colour: Bright yellow. Markings: No distinct markings, but the dry season form has more dusting and is paler.	*Eurema laeta* Boisduval (Plate 11, no. 61) Wingspan: Smaller, 30–45 mm. Colour: Yellow. Markings: In the dry season form, the fore wings are pointed, underside is pale yellow overlaid with light brown scales, with a darker oblique line.



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forests. It resembles the Common Grass Yellow in size as well as colour, but differs from it in having three instead of two black spots on the underside in the cell of the fore wing. It sometimes flies quite high near the tree-tops.

Among the seasonal forms exhibited by the four Grass Yellows, the dry season form of the Spotless Grass Yellow represents the maximum contrast from its wet season form. Both its wing form as well as the markings change dramatically between the seasonal forms (see the table).

Status, Distribution and Habitat The Common Grass Yellow is found all over India and is abundant in many places. It occurs in large open patches in the evergreen forests, in the semi-evergreen and deciduous forests and also in scrub, savannahs and near human habitations. In urban areas, it is among the most common butterflies. It is globally a widespread species, occurring in the tropical and subtropical areas of Africa, Asia and Australia.

Although it occurs round the year, it is most common in the post-monsoon months. However, in certain areas such as gardens and habitations, it may be seen in considerable numbers throughout the year owing to the variety of water and light regimes in these habitats and the availability of larval host plants and adult feeding plants in all the months.

Habits It has a weak fluttering flight. Although it is named 'grass yellow', it is not dependent on grasses, its caterpillars feed on legumes. However, its occurrence is often associated with grassy habitats, where it usually flies close to the ground among herbs and bushes. It may occasionally fly to the top of the trees seeking nectar from flowers.

It feeds mostly on the small, low-growing flowers. Asteraceae (=Compositae) members, such as species *Tridax*, *Lagascea*, *Bidens* and *Ageratum*, are its favourite flowers. It is also a regular member at the mud-puddling assemblages. In rare cases, it may be found on bird-droppings.

It is most active in the morning and at noon. During the hotter hours, especially in open areas in the forests, some individuals may rest on the undersides of leaves or on hanging grass-blades, herbs, etc. Sometimes the Spotless Grass Yellow and Common Grass Yellow sleep at night in the company of 4–10 individuals of their own species.

Annual fires adversely impact the Common Grass Yellow—whenever and wherever fires occur, their population registers a temporary decline. In all probability, the fires annually wipe out entire populations in small pockets of habitats. Because of their relatively poor ability to disperse, individuals from surrounding localities which have not been burnt take some time to recolonize the area.

Reproduction All the larval host plants of the Common Grass Yellow are leguminous. Their leaves are compound and remain closed when in the bud condition. The eggs are laid on such closed tender leaves. Each egg is spindle-shaped and stands on a narrow base. It is white when laid, turning yellow after a few hours' exposure, but always remaining shiny.

The little caterpillar is yellowish, slender and difficult to locate. It ususally rests on the upper or lower surface of leaflets, petioles and eats only the fringe of the leaflet. Later, as it grows bigger and dark green, it usually rests in the centre on the upperside of the leaflet. It then eats the leaves more extensively, reaching even up to the mid-rib. The caterpillar is cylindrical, dark leaf-green, sometimes with a faint white longitudinal line above the legs. Dispersed all over its body and head are conical tubercles, each one bearing a short white hair. These tubercles and hair look prominent under a hand-lens. The longer hairs bear drops of transparent liquid at their tips.

The caterpillar does not wander far and therefore pupation takes place on or near the host plant and close to the ground. The pupa has a loose body-band. It is laterally flat, bears a conical, short and pointed projection before the head and has a slightly parabolically

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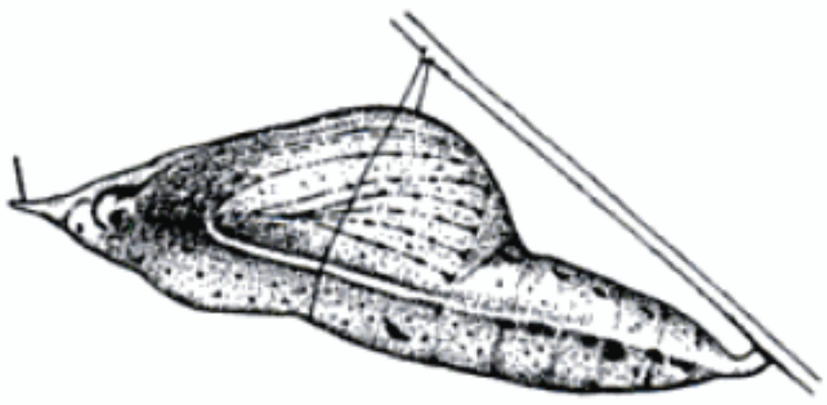


Length of caterpillar: 22 mm. Length of pupa: 17 mm.

curved wing-margin. The pupa is shiny green with a yellowish spiracular line. It is sometimes sprinkled with brown, dark grey and black dots.

Larval Host Plants The Common Grass Yellow is among the most polyphagous of butterflies in its larval stages. All its host plants are leguminous and belong to the families-Mimosaceae (acacias, touch-me-not and their relatives), Caesalpiniaceae (*Cassia*) and Fabaceae (=Papilionaceae, that is, gram and allied plants). New host plants are constantly being added to the list of known host plants and it seems as if the list will continue to grow.

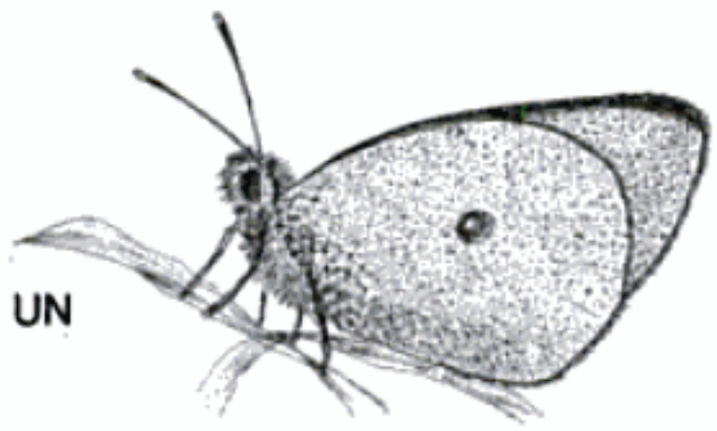
Suggestions for Student Projects Study whether there any is any ecological separation between the four species of the Grass Yellows. That is, do they use different habitats, nectar sources, larval host plants and occur in different seasons? Which species can co-occur in the same habitats and on the same host plants and adult feeding resources?

17. Nilgiri Clouded Yellow

(Plate 11, no. 62)

Scientific Name *Colias nilagiriensis* C & R Felder (Old: *Colias erate* Esper; given as subspecies of the Pale Clouded Yellow)

Field Characters Wingspan: 45–55 mm. The male is lemon yellow, and the female is white. The borders of its wings are black and the fore wing has a black spot at the cell-end. The hind wing borders may sometimes be reduced to only terminal well-separated black spots.



Medium-sized, yellow or white, with black borders

Status, Distribution and Habitat This is one of the butterflies endemic to the higher altitudes of the southern Western Ghats. It inhabits the shola–grassland mosaic of the Nilgiris, Anamalais, Palnis, etc., mostly above 1,500 m. It flies in open areas and is therefore common in and around cultivated or fallow fields, around tea-plantations and on open short grass- or herb-dominated meadows. It also frequents forest roads. It is active throughout the year.

Habits This is a very busy butterfly, one rarely sees it resting during the warm hours of the day. It is constantly on the move, fluttering rapidly within a metre from the ground, and moves around in no particular direction. Frequently, it halts to visit flowers

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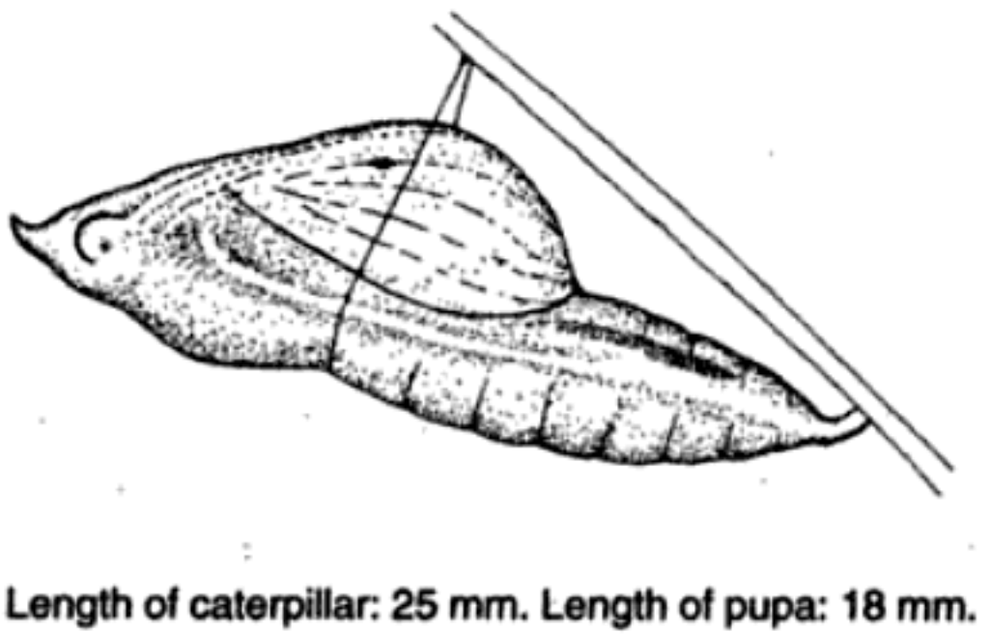
of small herbs, such as *Vicoa, Blepharistemma laebinia, Leucas, Crepis*, etc. and thus, is partial to asteraceous and lamiaceous herbs. It is always alert and difficult to follow or approach owing to its rapid flight, retiring nature and the type of terrain it inhabits. The females are almost as commonly seen as the males.

In cold weather it flies slower and sits more frequently and for a longer time. However, it always rests with its wings closed over the back with the fore wings slightly drawn between the hind wings. It settles low on the uppersides of grass-blades and herbs, often on the hanging portions.

Reproduction The caterpillar is cylindrical and pale leaf-green with a white and pink line on the sides. It stays on the undersides of the leaves. It may wander a few metres from the host plant in search of a suitable place for pupation. The pupa is green and laterally flattened. It has a small conical projection in front of the head.



Length of caterpillar: 25 mm. Length of pupa: 18 mm.

Larval Host Plants The caterpillars feed on *Parochetus communis*, a fabaceous herb that grows in meadows and in open areas around human habitation.

Importance The Clouded Yellows are Palaearctic (northern Eurasian) in origin. In the Indian subcontinent, they are present only in the Himalayan ranges and southern Western Ghats. Other originally Palaearctic butterflies which have similar distribution in India are the Indian Red Admiral and the Indian Cabbage White. These Palaearctic butterflies apparently invaded peninsular India in evolutionary times from the Himalayas, but became extinct as the peninsular Indian climate grew warmer in the course of the geological time-scale and the moist forests vanished. Thus, they became restricted to high altitudes in southern India—the Nilgiris, Anamalais, Palnis, Meghamalais, etc. in the southern Western Ghats, which were cooler and wetter. Here, the Nilgiri Clouded Yellow evolved to be a species distinct from its Himalayan counterparts, but the Indian Red Admiral and Indian Cabbage White retained their original characteristics. Earlier, the Nilgiri Clouded Yellow was considered a south Indian subspecies of the Pale Clouded Yellow but has been now given specific status.

Suggestions for Student Projects Since this species has originated in the temperate zone of Eurasia, it is expected to be much more immune to cold winters than other non-Eurasian butterflies which are found in its range. Compare the flight periods, activity patterns, seasonal occurrence and abundance pattern of this species with other high- and mid-elevation species of southern India to test this hypothesis.

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18. Common Jezebel

(Plate 11, no. 63)

Scientific Name *Delias eucharis* Drury

Field Characters Wingspan: 66–83 mm. The upperside of the wings of this butterfly is white, the underside is bright yellow with black veins and a marginal series of orange-red spots which are roughly pentagonal in shape. The female is more heavily marked.

UN

Medium-sized, white and yellow with black stripes and orange-red spots

Similar Species The only species similar to this is the Painted Sawtooth (*Prioneris sita* C & R Felder), which is of the same family. In this species, the orange-red spots on the underside of the hind wings are squarish. It flies faster and occurs only in dense forests. Unlike the Jezebel, it is fond of mud-puddling.

Status, distribution and habitat This species is omnipresent and active throughout the year. It occurs in all types of habitats except very thick wet evergreen forests and grasslands where its larval host plants are scarce. It is among the most prominent butterflies to visit city gardens. It is found only in the Indian subcontinent and is common wherever it occurs.

Habits This butterfly prefers to be in the canopy except when it is feeding on flowers of shrubs. Protected from predators by unpalatable alkaloids in its body tissues, it flies in a leisurely manner. However, it can travel long distances at a stretch when it is active. Flower nectar is the only nourishment it relishes. While in search of food, mates or host plants, both the male and the female fly from the level of the bushes up to 20–25 m above the ground.

It is most active during noontime and afternoons. During the morning hours the individuals may be seen basking on outstretched branches of tall trees with their wings closed, as all the dark markings that absorb the heat and warm the body are on the underside of the wings.

It sleeps on the overhanging branches of tall trees.

Reproduction The Common Jezebel, like the Pioneer, but quite unlike other Whites and Yellows, is a butterfly which lays eggs in batches, instead of laying them singly. Each batch consists of about ten to twenty eggs, although in rare cases up to a hundred eggs may be laid together. They are usually laid on the underside of leaves. The eggs are oval, shiny, and bright yellow. All the eggs from one batch hatch together. The new-born caterpillars devour the eggshells and then move on to eat fresh leaves. They live and feed together and always stay in a disciplined army fashion: all resting side by side with their heads in one direction, and whatever they do they do together. During the initial instars even moulting takes place simultaneously. However, each caterpillar has a different growth rate and some caterpillars grow faster. These full-grown caterpillars pupate early, others following them when it is time. The caterpillars wander as much as 20 m from the host plant to find a suitable place to pupate. They move somewhat slowly. If disturbed, they drop from the leaves and hang upside down with the help of a silk thread that they secrete as they drop down.

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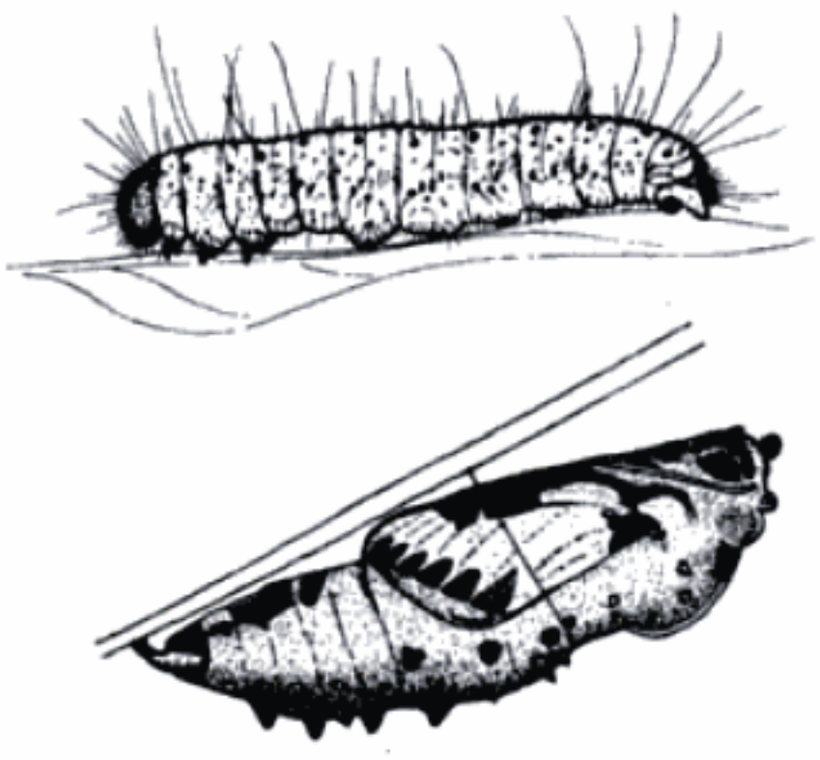
The caterpillars are a greasy yellow-brown with a jet-black head. They are unmarked except for the white, conical tubercles from which white long hairs arise. The pupa is a lighter shade than the yellow-brown caterpillar. It is marked with tubercles, numerous black spots and lines. It has a strong tail attachment and a tight body-band as supports. The early stages are heavily parasitized by flies. An entire batch of caterpillars may thus get destroyed.



Length of caterpillar: 14 mm. Length of pupa: 25 mm.

Larval Host Plants The host plants are various species of plant parasites, such as *Dendrophthoe falcata, Helicanthus elastica* and *Scurrula parasitica* of the family Loranthaceae. They are small hanging shrubs that grow on the branches of trees.

19. Psyche

(Plate 11, no. 64)

Scientific Name *Leptosia nina* Fabricius

Field Characters Wingspan: 35–50 mm. A bright white butterfly, the Psyche's fore wings have an apex with black borders. The only prominent mark is a big black spot on the fore wings. The underside is also white, but dull, overlaid with pale grey scales and marked with faint green striations. The wings appear papery because they are thin and therefore semi-transparent. The slow flight is characteristic of this butterfly.

Small, white with black markings

Status, Distribution and Habitat The Psyche lives in shaded places in gardens, secondary scrub derived from deciduous, semi-evergreen and evergreen forests and also in deciduous and semi-evergreen forests. Usually it keeps close to the undergrowth. It is most common from early monsoon to early winter, occurring in other seasons too, although in smaller numbers.

It is common all over peninsular India. Its global distribution extends over the entire Oriental region.

Habits In keeping with its delicate appearance, the Psyche's flight is extremely weak, fluttering and always close to the ground. When disturbed it flies erratically,

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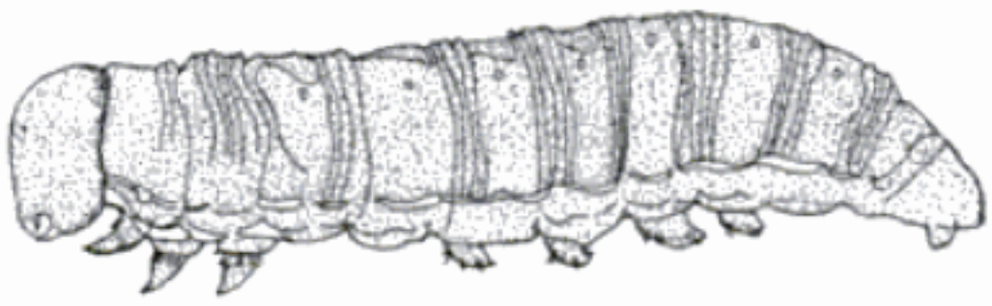
but not faster. If caught, it draws its legs close to the body, lies on the side and pretends to be dead. Its fiight is sustained and it takes a long time to settle. Before doing so, it investigates the spot by slowly hovering over it. If disturbed there, it again flies about for a long time searching for a new spot where to rest. Once it settles, the dull underside and greenish striations help to camouflage it. The black spot on the fore wings is its only distinct marking and it is hidden by drawing the fore wings between the hind wings. The butterfly does not show any special basking behaviour.

It feeds on small flowers such as *Tridax procumbens*, *Bidens* and *Alternanthera*. It very rarely visits wet soil.

Reproduction The eggs are laid singly on the undersides of leaves. The egg is spindle-shaped, whitish-blue and has 13 longitudinal ridges. The caterpillar stays on the upperside of the leaves, but may occasionally be found on the underside. It is dark green with a darker green dorsal line, an indistinct supraspiracular dark line and a whitish spiracular line. The body surface is covered with tubercles which bear hair. Each hair in turn has an amber-coloured liquid drop at its tip. The movements of the caterpillar are slow. It pupates close to the ground, among dense branches and usually on the host plant. Pupa is situated on the underside of a leaf or a twig and is supported by a loose body-band. In shape it is similar to the Common Grass Yellow's pupa, but the wing-cases are less bulging. The surface may be shiny and finely striated. The head projection is broader and shorter as compared to the Common Grass Yellow. The pupa is green or light brown, marked with black and dirty pink-brown dots.



Length of caterpillar: 17 mm. Length of pupa: 14 mm.

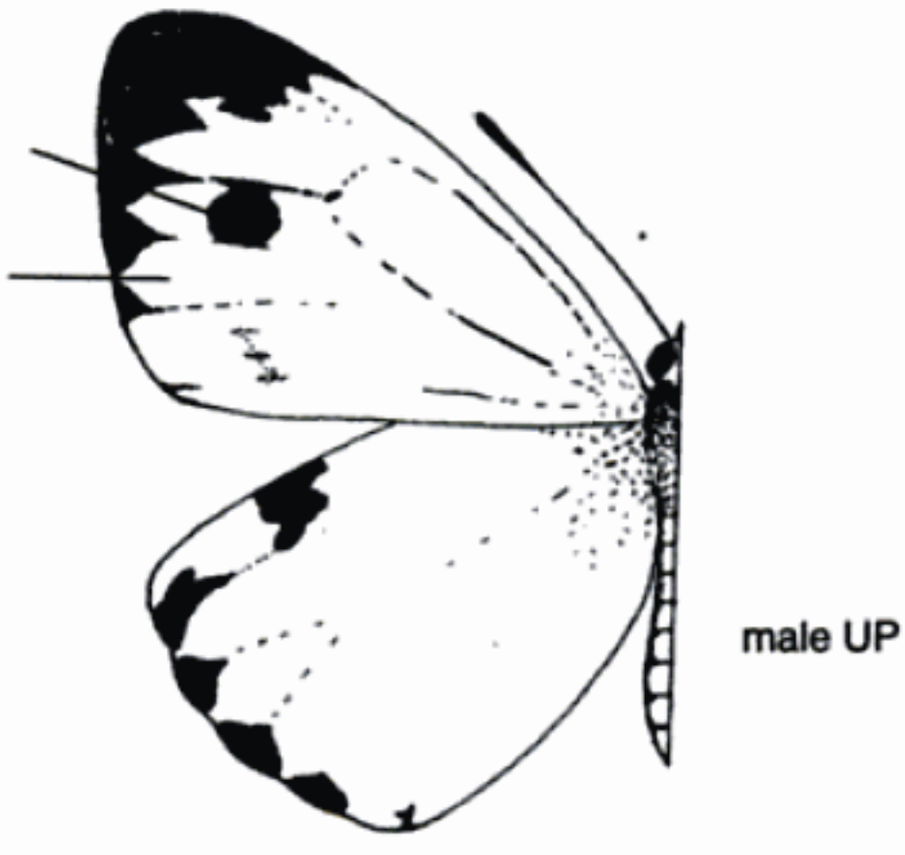
Larval Host Plants The host plants are members of family Capparaceae—*Capparis rheedii, C. spinosa, C. zeylanica, Cleome viscosa* and *Crateva adansonii.*

20. Indian Cabbage White

(Plate 11, no. 65)

Scientific Name *Pieris canidia* Linnaeus

Field Characters Wingspan: 45–60 mm. This is a predominantly white butterfly. The apex of fore wing on the upperside is black with a few terminal black spots. The hind wings have black marginal spots. A large black spot present in the outer half of the fore wings is visible on both wing surfaces. The underside of the hind wings is dirty white, densely dusted with dirty yellow, grey and greenish scales. Its dry season forms are more heavily dusted with such scales. The female has an additional black spot on the upperside of the fore wings.



male UP

Medium-sized, white with black markings

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Status, Distribution and Habitat The southern Indian population of this species is restricted to the shola forests, grasslands and agricultural fields at heights of above 1, 500 m, in the Nilgiris, Anamalais, Palnis, Meghamalais and other hilly regions. However, it has been recorded a couple of times from Bangalore. This butterfly is very common at the edges of sholas, on roads and in large clearings in the forests and around tea estates. As its larval host plants include cabbages and the kin of family Brassicaceae (= Cruciferae), it also inhabits cultivated fields in these areas. It is active throughout the year, but more common from the late monsoon months through summer.

Apart from southern India, it occurs northwards and eastwards from the Himalayas up to Japan, inhabiting areas with subtropical and temperate climate.

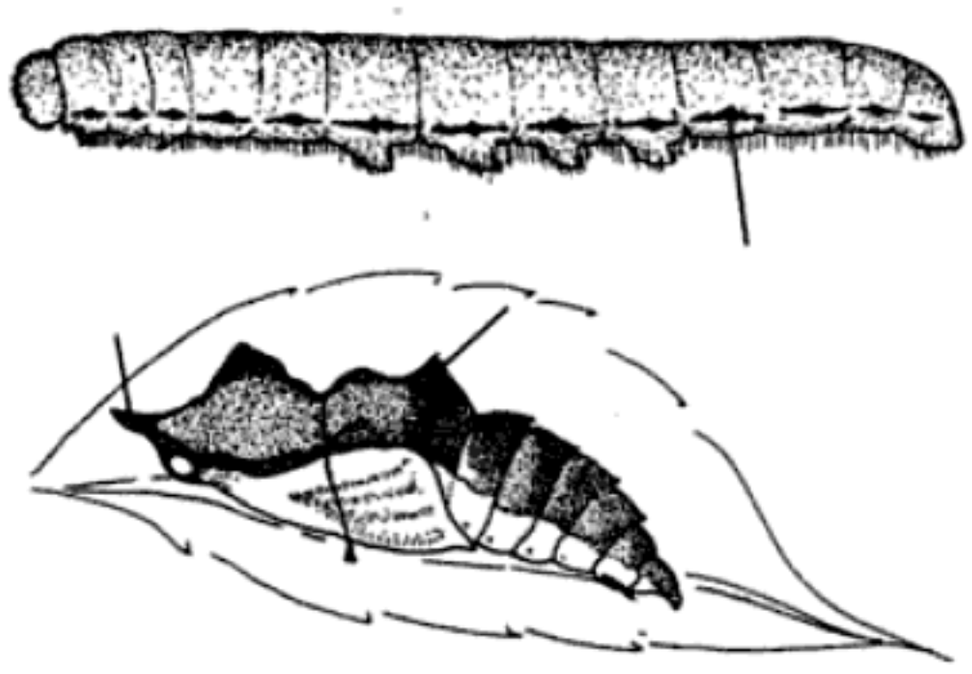
Habits In a typical dark shola forest that is disturbed by a road or in other major opening, this butterfly attracts attention because of its white colour and slow and fluttering flight. In the morning it flies in shorter bursts, settles often and basks with its wings either completely closed or half-open. Otherwise it settles close to the ground with its wings closed over the back. The fore wings are drawn between the hind wings so that only the dark and dusted wing portions are visible.

It keeps mainly to low levels but in openings or at the edge of the shola it may wander up small trees where it basks on the leaves. It seeks the flowers of herbs and shrubs and feeds mainly on asteraceous, lamiaceous and balsaminaceous species, such as various *Impatiens, Leucas, Vicoa, and Crepis*. The wings are kept closed while it feeds on the flowers. On hot days it can be found at mud-puddling sites. It is most active around noon and in the afternoon.

Reproduction The female lays its eggs on either surface of the leaves—one egg per leaf. The egg is white and spindle-shaped. The caterpillar rests on the lower surface of the leaves or on the main stem and petioles. However, it may move to the upper surface while feeding. It is dark green in colour, almost the same shade as the Common Gull caterpillar. A very thin, light yellowish line runs along the back. A series of yellowish-brown streaks is prominent near the spiracles on all the segments.

It pupates very close to the place where it had fed. The pupa is situated on the upper surface of the leaf and bound by a tight body-band. It is in much the same shape and position as that of the Common Gull. The colour is green and the projections and expansions on the pupa are also similar (compare the illustrations). The major differences lie in the position of the snout. In the case of the Indian Cabbage White the snout is shorter, pointed, more slender, straight and oriented slightly upwards, rather than curved downwards as in the Common Gull.

Larval Host Plants The larval host plants are small herbs which include cabbages and its relatives from the same family—Brassicaceae or Cruciferae.



Length of caterpillar: 27 mm. Length of pupa: 20 mm.

Economic Significance The caterpillars of this species are regarded as minor pests of cabbage. Occasionally, though, their populations explode, posing a serious threat to the crop. At such times, despite the use of mechanical or chemical means to eliminate the infesting generation, it becomes a difficult task to handle owing to the butterflies' fecundity.

Importance and Suggestions for Student Projects Refer to the Nilgiri Clouded Yellow.

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21. Common Gull

(Plate 11, no. 66)

Scientific Name *Cepora nerissa* Fabricius
(Old: *Huphina nerissa* Fabricius)

Field Characters Wingspan: 40–65 mm. It is predominantly white on the upperside and yellow on the underside. The wing margins and veins are black. The veins are faint on the upperside but prominent on the underside. The females are more heavily marked. The wet season forms are bright yellow and deep black while the dry season forms are dull yellow and faint black.

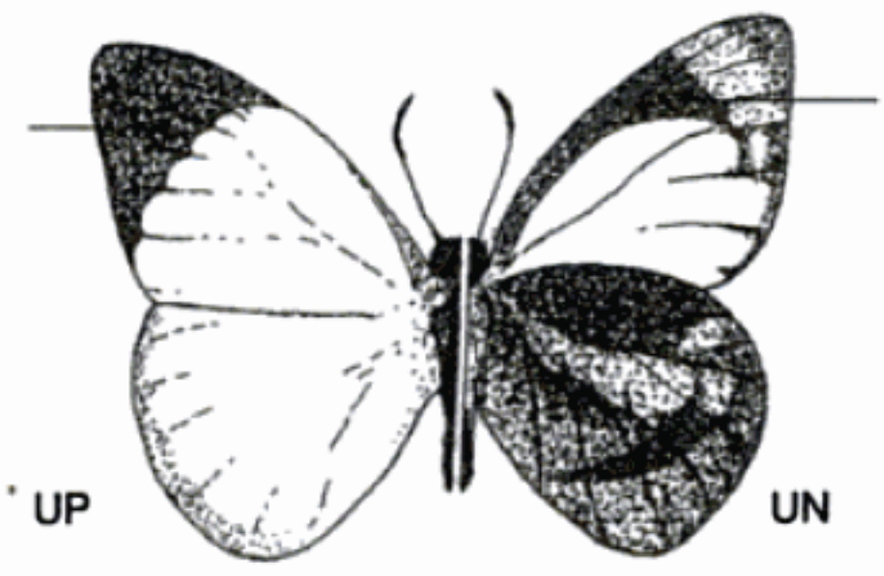
Male UP

Female UP

UN

Medium-sized, white and yellow with black markings

Similar Species The Pioneer looks very similar. However, it can be easily distinguished because of the presence of a hockey-stick-like mark on the fore wing. The Lesser Gull (*Cepora nadina* Lucas) is a white butterfly with the tips of the fore wings broadly black. Its underside is yellow with a dusting of black and chocolate-brown scales.



Lesser Gull

Status, Distribution and Habitat It is a common butterfly in the savannahs, scrub and dry deciduous forests of the plains and the low-lying hills of India. It is also found in degraded forests and occasionally visits gardens. It prefers open, sunny patches. It is most common between the pre-monsoon and post-monsoon months and its numbers decrease gradually towards the end of the monsoon as well as in the dry season.

Its global distribution extends over the entire Oriental region.

Habits The Common Gull flies rapidly but always close to the ground. In the morning it flies jerkily with occasional abrupt halts to land on some leaf or a grass-blade to bask in the sun. While basking it holds the wings three-quarters open, but at other times closes them completely. Once it is warm enough, it is a very active butterfly. It flies among the bushes and grass, and occasionally small trees, in search of flowers. Nectar is its main nourishment, although in the summer, the males gather in large numbers on wet soil

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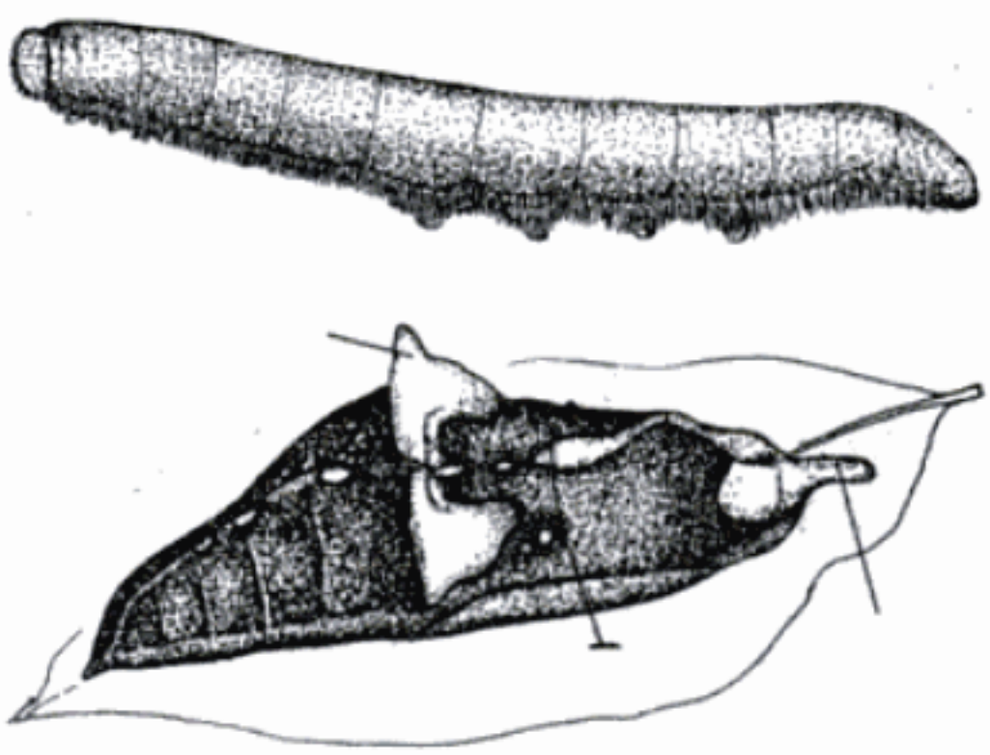
patches. The flowers are investigated leisurely and, therefore, it may spend a long time on flowers, especially if they are in inflorescence.

It is active from a little after sunrise until late afternoon, its activity peaking during the late morning and noon hours.

Reproduction Its courtship and mating behaviour are similar to that of the Common Emigrant. The eggs are laid singly on the undersides of young leaves. The egg is white in colour and bottle-shaped. It turns yellowish before the caterpillar hatches out of it. Infertile eggs turn pinkish red. The caterpillar is a uniform dark leafy green throughout its lifetime and is unmarked. It has a dense fringe of whitish hair above the spiracular line. The rest of its body is also covered with minute erect hair, visible only when the caterpillar is viewed against the light. Each hair bears a colourless droplet at its tip. The caterpillar eats only fresh leaves. It always stays on the upperside of the leaves, on the mid-rib when it is at rest. It moves very slowly and feeds at night or when the light is low. The water content in the leaves of its larval food plant, *Capparis zeylanica*, is very low and therefore the droppings of the caterpillar are dry.

The caterpillar turns light green just before pupation. The pupa is greenish and therefore camouflages itself well among the leaves. Its position is unusual—it is always on the upperside of a leaf, in contrast with most butterfly pupae which are found on the undersides of the leaves and twigs. It has a tight body-band. A short and curved projection is present in front of the head. The junction of the thorax and the abdomen has a small flat projection that points outward on the sides. The butterfly emerges within a week or week-and-a-half.

The caterpillars are sometimes infected by parasitoid Ichneumonid wasps. The parasitoids pupate inside the pupae of the Common Gull and the adult wasps emerge through the pupae after a week or two. The infected butterfly pupae turn dark brown and then are easy to locate since they lose their camouflage.



Length of caterpillar: 27 mm. Length of pupa: 20 mm.

Larval Host Plants The host plants are various species of capers (*Capparis*) of the family Capparaceae. The capers are mostly woody climbers or climbing shrubs that grow in deciduous forests and scrub and also in neglected corners of gardens. They overgrow neighbouring small trees and fences and have a pair of hooked spines in the leaf axil. The species recorded as the hosts of the Common Gull include *Cadaba fruticosa, Capparis decidua, Capparis rheedii, Capparis sepiaria, Capparis zeylanica* and *Maerua oblongifolia*. Among these, *Capparis zeylanica* is the most commonly used plant.

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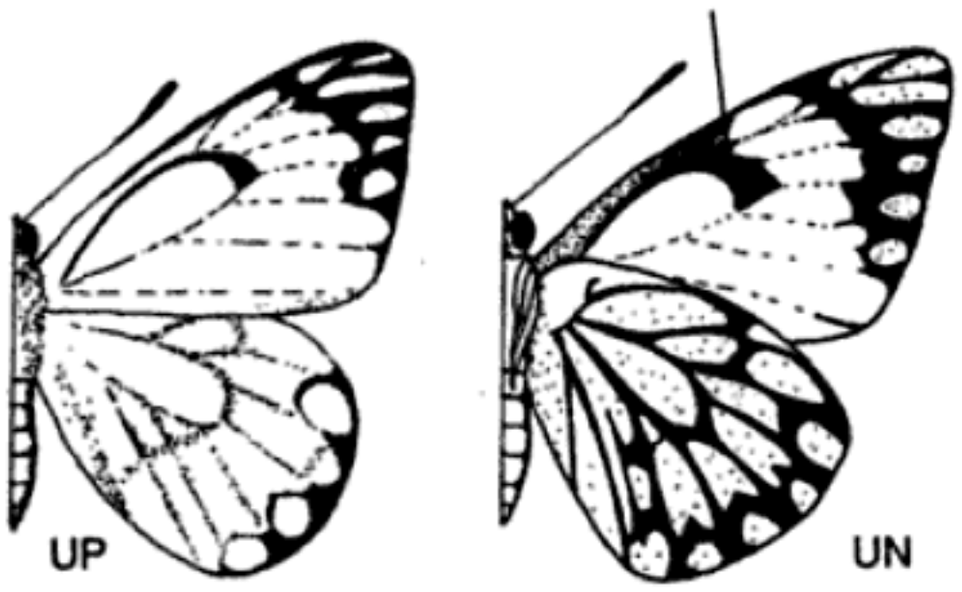
22. Pioneer or Caper White

(Plate 12, no. 67)

Scientific Name *Anaphaeis aurota* Fabricius (Old: *Belenois mesentina* Moore)

Field Characters Wingspan 40–55 mm. The upperside is white with black apical markings and a distinct 'hockey-stick' mark at the front margin of the fore wings. The hind wings are unmarked except at the margin. The underside is bright yellow with marginal markings and black bands along the veins. The males are brighter yellow with thinner black bands as compared to the females. The females are usually larger. The dry season forms are white on the underside instead of yellow.



Medium-sized, white and yellow with black markings

Similar Species The Common Gull is similar but lacks the hockey-stick marks, and the black borders on its uppersides are thicker.

Status, Distribution and Habitat This is a dry-zone butterfly, found in savannahs, scrub and dry deciduous forests. In these habitats it is abundant in the pre-monsoon months and common until the end of the monsoon. During the winter and early summer, it may be absent in certain areas. These local variations are probably governed by site-specific moisture gradients, temperature regimes and phenophases of available host plants.

The global distribution is extensive, covering Africa and south Asia.

Habits The Pioneer flies rapidly, usually with fluttering wingbeats. It follows an irregular path with up-and-down and sideways deviations. The butterfly is easily attracted to flowers. Nectar-rich species, such as *Lantana, Tridax, Gmelina* and *Maerua* hold a strong attraction. It is wary while feeding and takes off on approach.

The males assemble on wet soil patches and in rare cases up to several hundred may form a mud-puddling group.

The only time one can find this butterfly sitting lazily is when it is basking. It spreads its wings halfway or completely closes them, since there are more black markings on the underside of its wings.

Reproduction The surroundings of the host plants are always crowded with dozens of these butterflies. The newly-emerged individuals are quick to find mates. When a male flutters close by, a receptive female sits on the ground with its wings half-opened. The male lands on it, grabbing its abdominal tip with its clapsers and takes off. After the eggs are fertilized the female finds a suitable branch and lays a batch of eggs on the lower surface of a leaf. The Pioneer is among the unusual butterflies that lay eggs in large clusters. The clutch size varies from about 20 to over 150 eggs. However, the total number of eggs the female lays in its lifetime is not known. The eggs are yellow and spindle-shaped with vertical ridges and minute ornamentation on the surface.

Since the eggs are laid in large batches, the caterpillars stay together. The group size gets even larger when more than one female has laid its clutches close together. The very young caterpillars are greenish and smooth. As they grow they develop broad black bands on the sides. The back remains a fresh leaf-green with a central, darker green line. The head turns black and the white dots on it, each bearing a short white hair, become distinct. Below the spiracular line is a series of very long white hairs. The first meals of the caterpillars are eggshells. In the first few days

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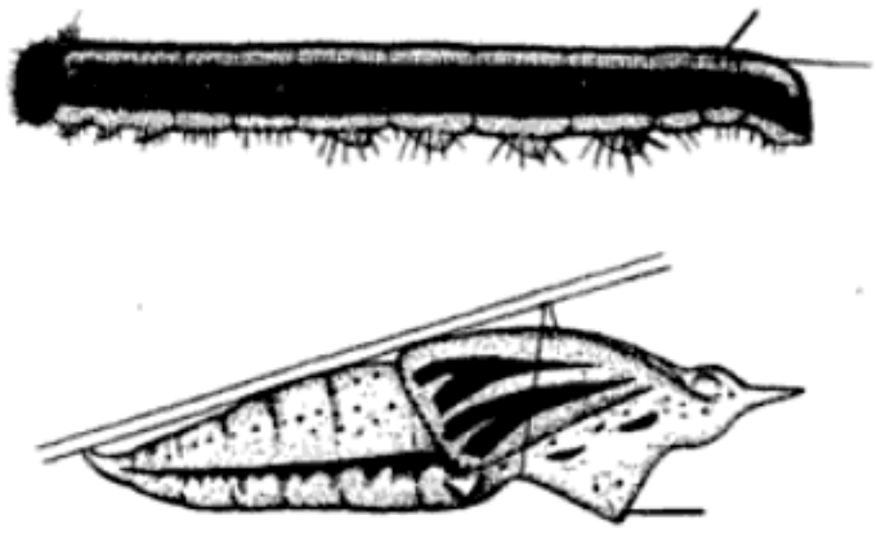
after hatching, the caterpillars cannot eat entire leaves and eat only the inner soft tissue leaving behind colourless papery layers of skeletal tissue. Later, as they grow, they strip off the branches, devouring leaf after leaf.

The pupa is whitish to pale brown. It has a small projection on the head and two on the sides of the thorax, besides the large conical thoracic point. It is marked with black lines, dustings and spots. It is supported by a tight body-band. At the peak of the breeding season, when they are in high densities, the caterpillars pupate close to each other, usually at the tip of the branch. Sometimes the branch is so crowded that the caterpillars pupate on top of each other. If a particular host plant is large enough with abundant foliage, several generations may be raised on the same plant.

As the caterpillars live in large groups and do not hide, they are easy to locate and prone to predation and parasitization. Once they discover a flourishing population of the Pioneer caterpillars, the parasitic wasps, especially the chalcid wasps, take a heavy toll on them. Apart from the wasps, an unidentified microbial infection kills a considerable proportion of the caterpillars. The infected individuals develop a black constriction on the body. This constriction kills the caterpillar in a few days time since it deepens progressively as the body grows.



Length of caterpillar: 35 mm. Length of pupa: 22 mm.

Larval Host Plants The caterpillars feed on Capparaceae: *Capparis decidua, C. pyrifolia, C. rheedii, C. sepiaria, C. spinosa, C. zeylanica, Cadaba fruticosa* and *Maerua oblongofolia.*

Suggestions for Student Projects The adult Pioneer and Common Gull are morphologically and behaviourally similar species. Their size, markings, larval host plants and adult nectar sources are apparently similar. The major differences are in preferred habitats and that the Common Gull caterpillars are solitary. Breeding in the Pioneer is also suspected to be seasonally restricted, while the Common Gull breeds for a longer period of time in a year. A study of detailed breeding and feeding behaviours of the Common Gull and the Pioneer could reveal factors that ecologically separate these species—parasitoids, the gregarious breeding of the Pioneer and other finer behavioural details could be playing a key role.

23. Common Albatross

(Plate 12, no. 68)

Scientific Name *Appias albina* Boisduval

Field Characters Wingspan: 60–75 mm. The male is unmistakable because it is completely milky white, sometimes tinged light yellow. It is unmarked except for black apical scales and a narrow border on the upperside of the fore wings. There may be marginal black spots on the hind wings. The underside is plain glossy white with only the

Common Albatross female

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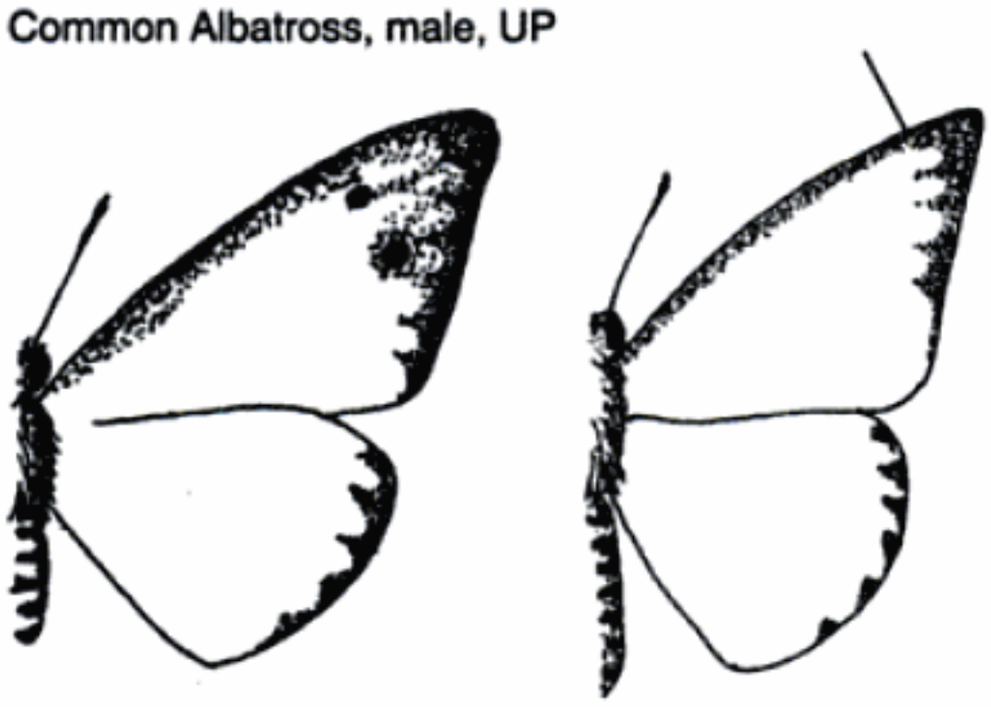
Common Albatross, male, UP

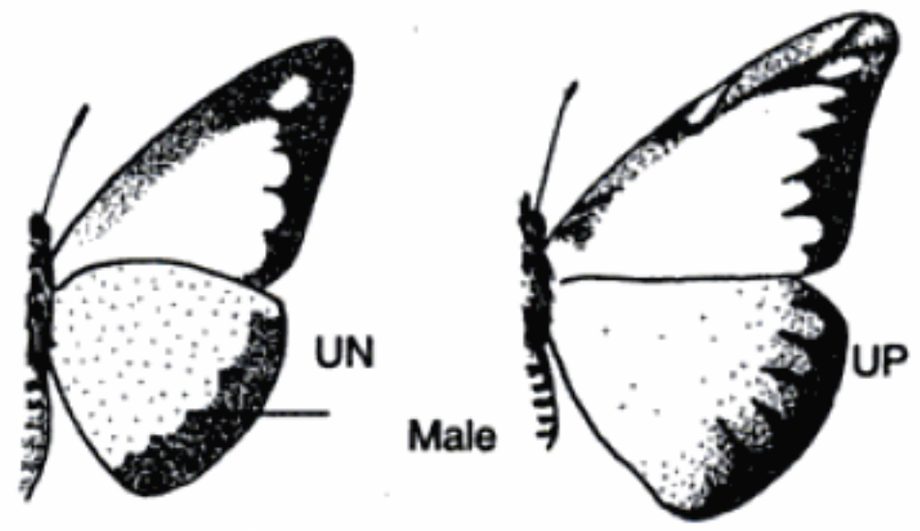


Medium-sized, white with black markings

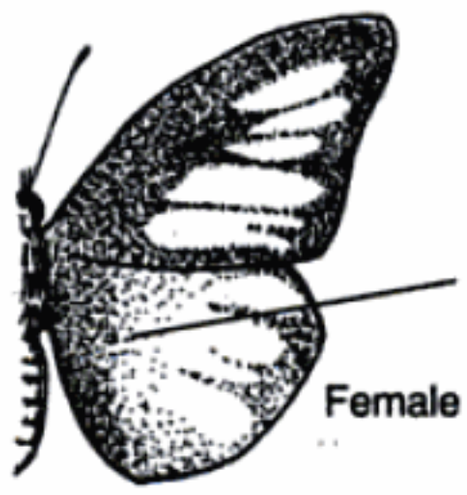
front margin of the hind wings narrowly yellow. The female is white with black wing margins. The apex of the fore wing is black and encloses a few small white spots.

Similar Species The Lesser Albatross (*Appias wardii* Moore) is so similar to the female of the Common Albatross that the two cannot be differentiated in the field. In fact, because of this similarity, these two species were once pooled with another similar Sri Lankan species and given the status of a single species. They all share common habitat and have similar habits.

The other species of Albatross in peninsular India are relatively easy to distinguish (see the illustrations). The Striped Albatross (*Appias libythea* Fabricius) males look very similar to males of the Common Albatross and cannot be distinguished in the field unless they are caught and closely examined for their wing venation. However, the Striped Albatross inhabits dry deciduous forests and scrub jungles, whereas the Common Albatross is found in evergreen and semi-evergreen forests. The female of the Striped Albatross is white and has a broad, black, terminally down-curved band at the front margin of the fore wings. The Chocolate Albatross (*Appias lyncida* Cramer) male is white on the upperside with black or chocolate-brown margins. On the underside it is bright lemon yellow with chocolate-brown margins. Its female is white but heavily clouded with dark brown. The Plain Puffin (*Appias indra*

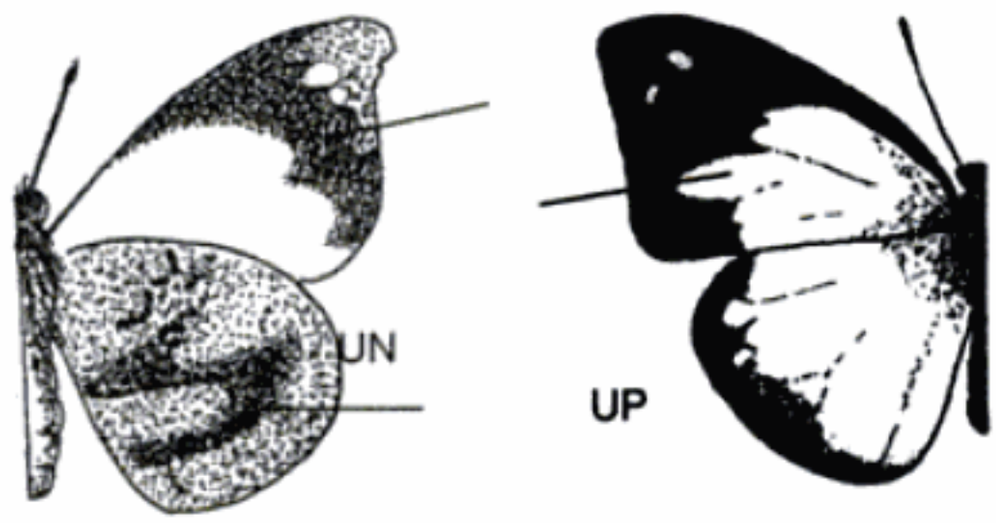


Chocolate Albatross



Striped Albatross UP female

Dry season form **Wet season form**



Plain Puffin female

Plain Puffin male UP

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Moore) (Plate 12, no. 69) is white with black borders, which are narrow in the male and broader in the female. It is somewhat similar to the Common Albatross and Lesser Albatross but unlike them, is heavily dusted with dark brown scales on the underside of its wings.

All the species mentioned above are relatively uncommon as compared to the Common Albatross.

In flight, the male of the Common Albatross may be confused with the Emigrants. However, at rest the Albatross may be easily distinguished by its more pointed, narrower and unmarked wings.

Status, Distribution and Habitat This butterfly is found in the evergreen and semi-evergreen forests, especially in the openings, and at the edges and streambeds. Locally, this is a common species that is abundant and often dominant in terms of its population size at the right places and in the right seasons. The males are far more numerous than the females. It is more frequent in the post-monsoon months and the summer, but usually very rare in the thick of the monsoon. It is distributed in forests of southern India and from northeastern India to southeast Asia and parts of Australia.

Habits Most of the Common Albatross that one encounters are males. The females are rarely seen and they keep to shaded places in the forest. The species on the whole is very fast on the wing. Height is no bar for this butterfly and it is seen feeding on the flowers of low-growing herbs as well as those of giant lianas and large canopy trees. It is almost equally common in all the vegetation layers. The individuals fly singly but at a forest edge or near a good stream there are so many of them that they appear to be in a group.

It is fond of flowers. Unlike other butterflies, when it is feeding at the flowers it keeps its wings slightly open and steady. Other butterflies usually keep them either closed, spread or fluttering. In summer, the males and in rare cases the females, also visit wet soil patches. The swarms on wet soil sometimes consist of several hundred butterflies. Butterflies from a group always crowd together, although there is usually enough space for them to stay slightly apart. This tendency to form crowded and compact groups might have arisen to reduce individual chances of predation while mud-puddling. If the group is disturbed, all the butterflies take wing as a single mass, but immediately disperse and many of them do not settle again at the same spot. On the stream banks, a dozen or more individuals may be seen flying in a single file in a follow-the-leader fashion, turning and twisting as their leader moves, and appearing like a white string in motion.

This butterfly basks with its wings closed over the back. On very hot days it may rest in the shade or on the underside of leaves. At rest, the fore wings are almost completely drawn between the hind wings, leaving only the tips of the fore wings exposed.

This is a butterfly with strong migratory habits. At apparently unpredictable intervals, migratory swarms are formed and anything between a few dozen to thousands of individuals may participate in such migrating swarms. These swarms may consist of more than one species.

Reproduction The eggs may be laid in very small batches. Each egg is yellow and bottle-shaped. The new-born caterpillar is pale yellow and merges well with veins on the leaves. Later, as it grows, it acquires a beautiful, rich, cerulean-blue tint. However, the head remains yellow throughout its life. The surface of the body and head is covered with jet-black conical tubercles, which bear fine, minute hair at their tips. It is light lemon yellow on the underside and a line of similar colour runs along the length of the body behind the head.

The caterpillar feeds on young leaves and buds, avoiding mature leaves. It rests on the underside of the leaves, without making any effort to conceal itself and its bright colours also make it very prominent.

The pupation takes place on the underside

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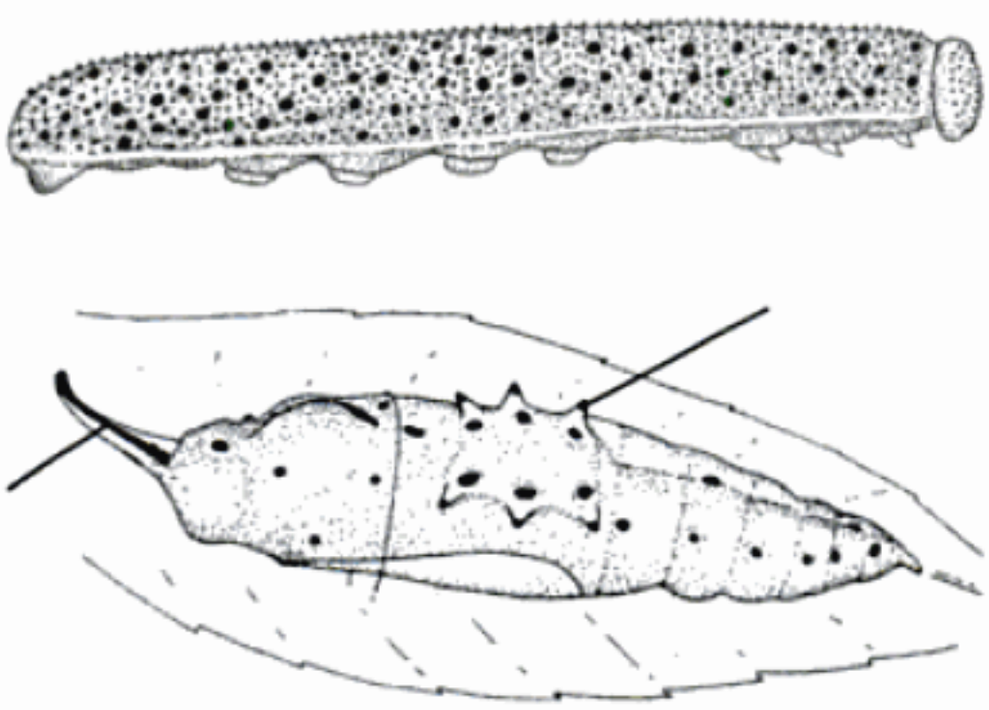
of the host plant as the caterpillar does not wander. The pupa is yellow, the shades of which may vary, with a few small black spots. It has a long, pointed, upturned projection in front of the head, with a black line on top. Behind the thorax are three pairs of flat, sideward projections, whose tips are black.



Length of caterpillar: 35 mm. Length of pupa: 23 mm.

The butterfly emerges after a week.

Larval Host Plants The caterpillars feed on *Drypetes oblongifolia, D. roxburghii* and *D. venusta*, all small trees that grow in the evergreen forests.

Suggestions for student projects All insects are cold-blooded heliotherms, that is, they depend on the heat of the sun to warm themselves in order to be physiologically active. Butterflies do not become active until they raise their body-temperature to a certain level. Many butterflies have dark wings or dark veins. The dark scales absorb heat quickly, thereby hastening the process of increasing their body temperature. The Common Albatross, especialy the male, is completely white, so it must absorb heat less efficiently. Do this and other white butterflies show any special basking behaviours and physiological adaptation to overcome this possible problem?

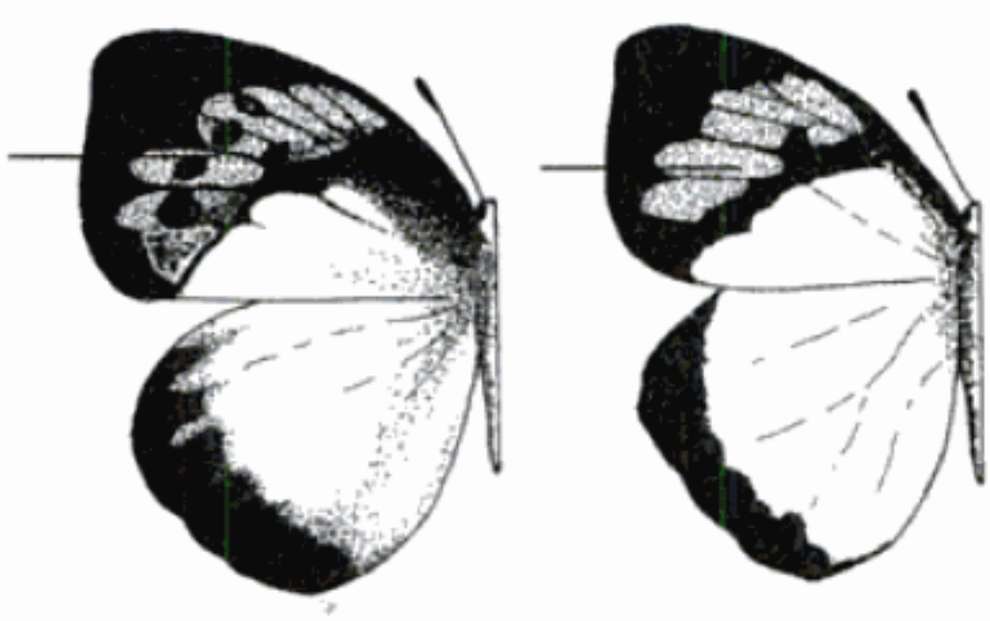
24. White Orange Tip

(Plate 12, no. 70 & 71)

Scientific Name *Ixias marianne* Cramer

Field Characters Wingspan: 50–55 mm. The White Orange Tip is white on the upperside with broad black borders on the wings and an orange fore wing apex. This characteristic confers on it an unmistakable identity and its name. The female has a row of black spots in the orange portion. The underside is bright yellow with a few rusty brown spots on the hind wings.

White Orange Tip



Female UP Male UP

Medium-sized, white with orange tip and black borders

Similar Species The upperside of the wings of the Yellow Orange Tip (*Ixias pyrene* Linnaeus) (Plate 12, no. 72) is yellow, instead of white. The Small or Little Orange Tip (*Colotis etrida* Boisduval) (Plate 13, no. 73) and Plain Orange Tip (*Colotis eucharis* Fabricius) are much smaller in size (wingspan: 25–45 mm) and their undersides are white instead of yellow. In the case of the Plain Orange Tip, the orange wing tip is not completely enclosed by the black border. The Crimson Tip (*Colotis danae* Fabricius) (Plate 13, no. 74) is smaller (wingspan: 40–50 mm) and has bright crimson wing tips.

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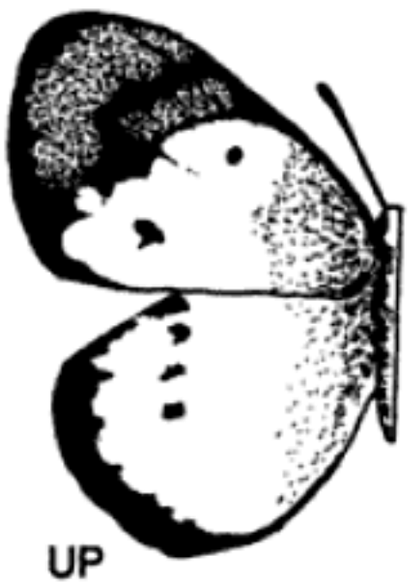
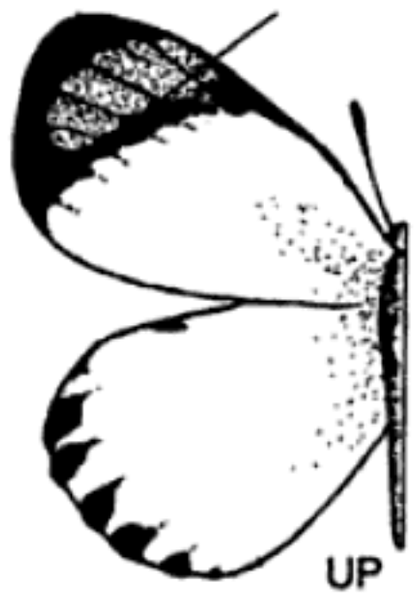
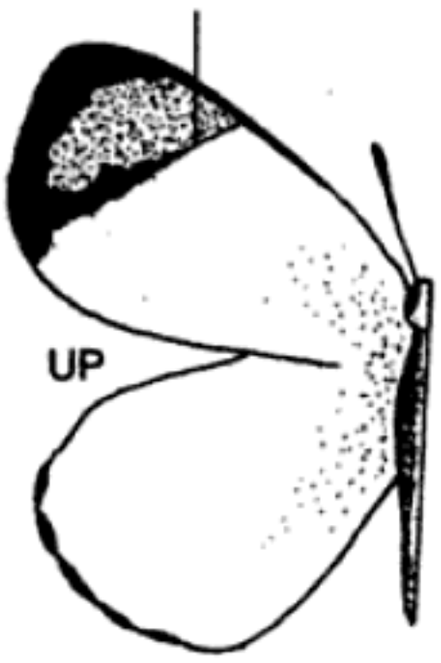


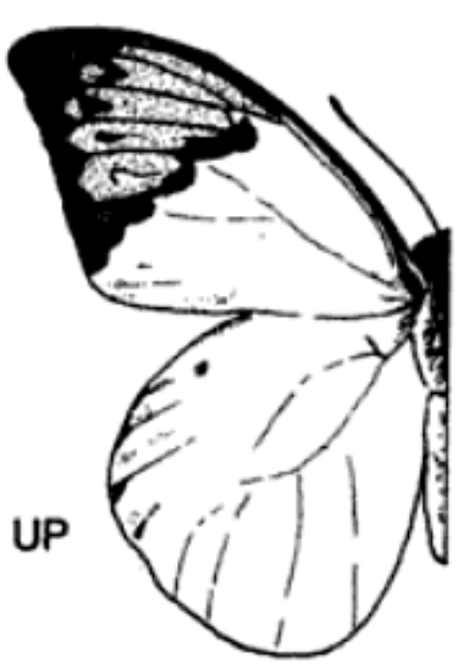
Crimson Tip



Little Orange Tip



Plain Orange Tip



Great Orange Tip

The Great Orange Tip (*Hebomoea glaucippe* Linnaeus) (Plate 13, no. 75) is the largest of the Orange Tips (wingspan: 80–100 mm.) and one of the strongest and fastest fliers among Indian butterflies.

Status, Distribution and Habitat It is restricted to Sri Lanka and peninsular India and distributed throughout the plains and lowlands. It is common in dry deciduous forests, scrub and fallow lands and found throughout the year. However, it is more common during the monsoon and post-monsoon and considerably rare in the summer.

Habits Due to its coloration, the White Orange Tip is the most striking of the scrubland butterflies. It flies among bushes and small trees, usually within three metres off the ground, where it feeds on nectar from flowers. It flies rapidly and flutters its wings, and the wing-beats are continuous. However, its flight is erratic.

In summer, the males gather on damp patches and feed in the company of butterflies such as the Emigrants, Grass Yellows and the Lime Butterfly. While feeding from wet soil or resting, the fore wings are drawn between the hind wings.

The females are seen less often than the males. They keep close to the larval host plants and probably remain passive while searching for mates. Like the males, they bask in the sun with their wings held three-quarters open.

The butterfly participates in migratory swarms, but its numbers in such swarms are always very small. Moreover, it does not usually form migratory swarms of its own.

Reproduction The eggs are laid in batches of two to four, on very fresh shoots of the plant and usually within 2 m of the ground. The egg is yellow and bottle-shaped. Infertile eggs turn reddish. The caterpillar hatches after 3–4 days. It is slender and cylindrical with a rounded and plain green head. Each of its body segments has transverse skin folds and it therefore looks wrinkled. It is green in colour and has two closely placed, narrow red lines near the spiracles, which run from the second to the last segment. It always stays on the tender shoots, preferably on the undersides of leaves and stays camouflaged. It eats the young leaves from the sides and near the tips, leaving the basal and central portions of the leaves intact.

The pupa is formed on the underside of a leaf and is supported by a very loose body-band. If disturbed, it jerks sideways with a

Length of caterpillar: 29 mm. Length of pupa: 19 mm.

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violent movement. It is angular and the wing-cases are parabolic in outline. A short, upwardly curved projection is present in front of the head. The colour of the pupa is either green or brown, to aid camouflage, the colour depending on the surrounding objects. The pupa is without any prominent markings.

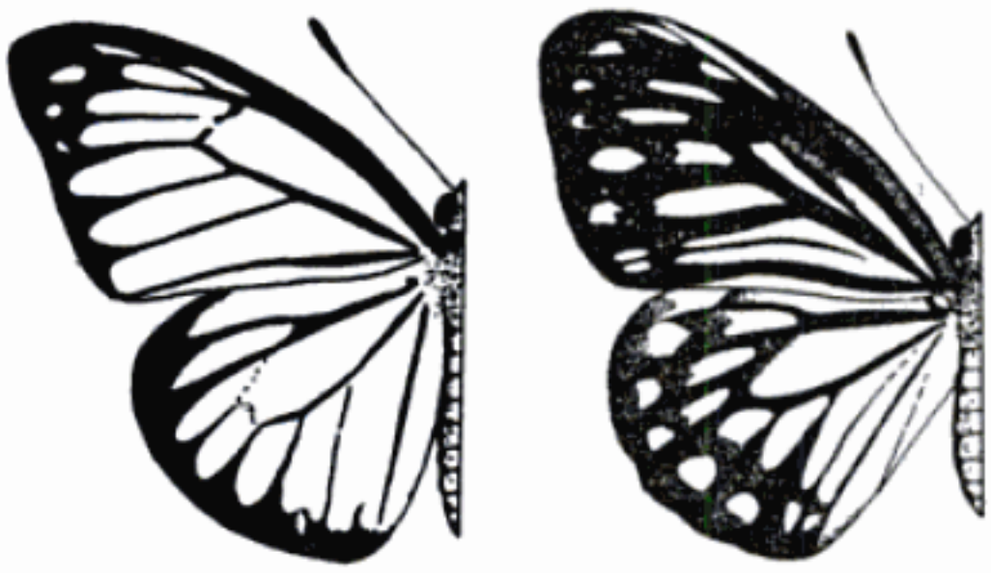
Larval Host Plants The caterpillars feed on woody or tree species of capers (family Capparaceae). The recorded host species include *Capparis decidua, C. divaricata, C. grandis* and *C. sepiaria*, of which, *Capparis grandis* is preferred whenever available.

25. Common Wanderer

(Plate 13, no. 76 and Plate 20, no. 119)

Scientific Name *Pareronia valeria* Cramer

Field Characters Wingspan: 65–80 mm. The male is shiny sky-blue with black margins and veins. The female is a light bluish-white with broader margins and veins. The markings on the underside are similar to those on the upperside, except that they are grey-brown and not well-defined.



Male UP Female UP

Medium-sized, sky-blue or bluish white with black markings. Female mimics Blue Tiger.

Similar Species The Dark Wanderer (*Pareronia ceylanica* C & R Felder) male is similar in appearance to the Common Wanderer, except that it has a very broad wing margin. The females of these two species cannot be easily distinguished in the field from each other. The Dark Wanderer is restricted to thick evergreen and semi-evergreen forests of the southern and central Western Ghats, while the Common Wanderer prefers open forests.

The female Wanderers mimic the Blue Tiger (see the section on Blue Tiger for details of field identification).

Status, Distribution and Habitat The Common Wanderer is found in areas of moderate to high rainfall. Here it inhabits open forests, dense scrub, woodlands, etc., where light is in abundance. It is also regularly seen in well-wooded parts of urban areas. It is distributed over India, Myanmar and other parts of the Oriental region.

Habits The characteristic wandering flight of this species has given it its name. The males fly untiringly between 1–5 m above the ground, rarely rest and bask with their wings open. Their flight is usually moderate, neither fast nor slow, but when disturbed it can be erratic and fast.

The females are much less commonly seen than the males. The females, since they mimic the Blue Tiger, fly slowly. They settle often and rest on the uppersides of the leaves for a long time. They may sit in very open places close to the ground under a height of about 1 m or so. They are relatively sedentary as compared to the males. The males, therefore, search actively for the females.

Both the sexes sleep on the undersides of leaves, generally at the end of a branch.

It feeds only on flowers. It has a very long proboscis, which is about 3 cm in length. Therefore, it can access nectar from flowers with long corolla tubes, such as *Plumbago*,

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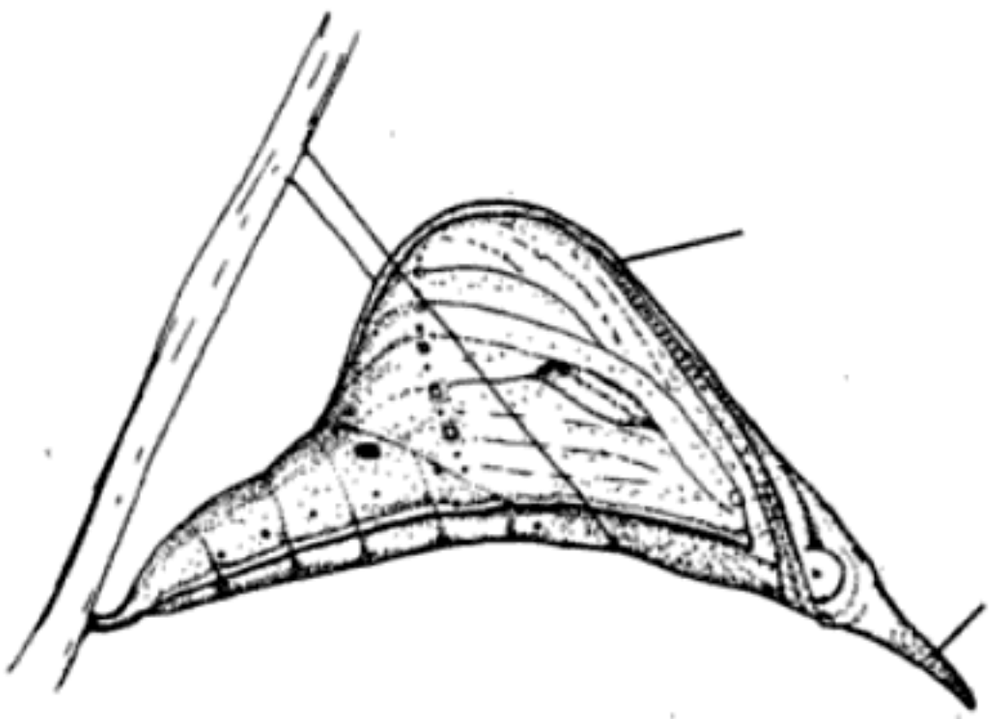
but it also visits flowers with shorter corolla tubes.

Reproduction After mating, the female finds a suitable plant to lay its eggs. The eggs are laid in small batches of about half-a-dozen or so, but the caterpillars later disperse. The egg is oval with a pointed top. It has 17 longitudinal ridges, is whitish and somewhat shiny. A day after it is laid, it develops four faint, rosy, horizontal lines. These lines get darker until the caterpillar hatches.

The caterpillar is completely dark green and matches the colour of the leaf on which it rests. The last segment has two fleshy, minutely hairy, conical processes. Each process bears a long hair at its tip. The body is covered with tubercles that bear a single, long, whitish hair whose tip may have a droplet of colourless liquid. The hair and droplets may be easily visible when the caterpillar is viewed against the light. The caterpillar may sometimes be marked with brown diagonal lines and blotches on its sides.

The caterpillar stays always on the mid-rib on the upperside of a leaf. It weaves a shiny silky pad on the leaf surface on which it rests. It eats the leaves at the edges and generally moves over to new leaves, without completely finishing off the earlier ones.

At the time of pupation, after the body-band is made, the caterpillar turns pale green. If the markings are present, they fade and vanish completely. The pupal surface is dull. It is green with a series of black dots at the wing margins and a pale spiracular line. The most prominent features of the pupa are the parabolic bulges of the wing-cases and a long, pointed, straight projection in front of the head. The body-band is very long.



Length of caterpillar: 41 mm. Length of pupa: 30 mm.

Larval Host Plants Woody climbers of family Capparaceae: the capers, namely, *Capparis rheedii* and *C. zeylanica* are reported as the larval host plants, but the latter is more commonly used.

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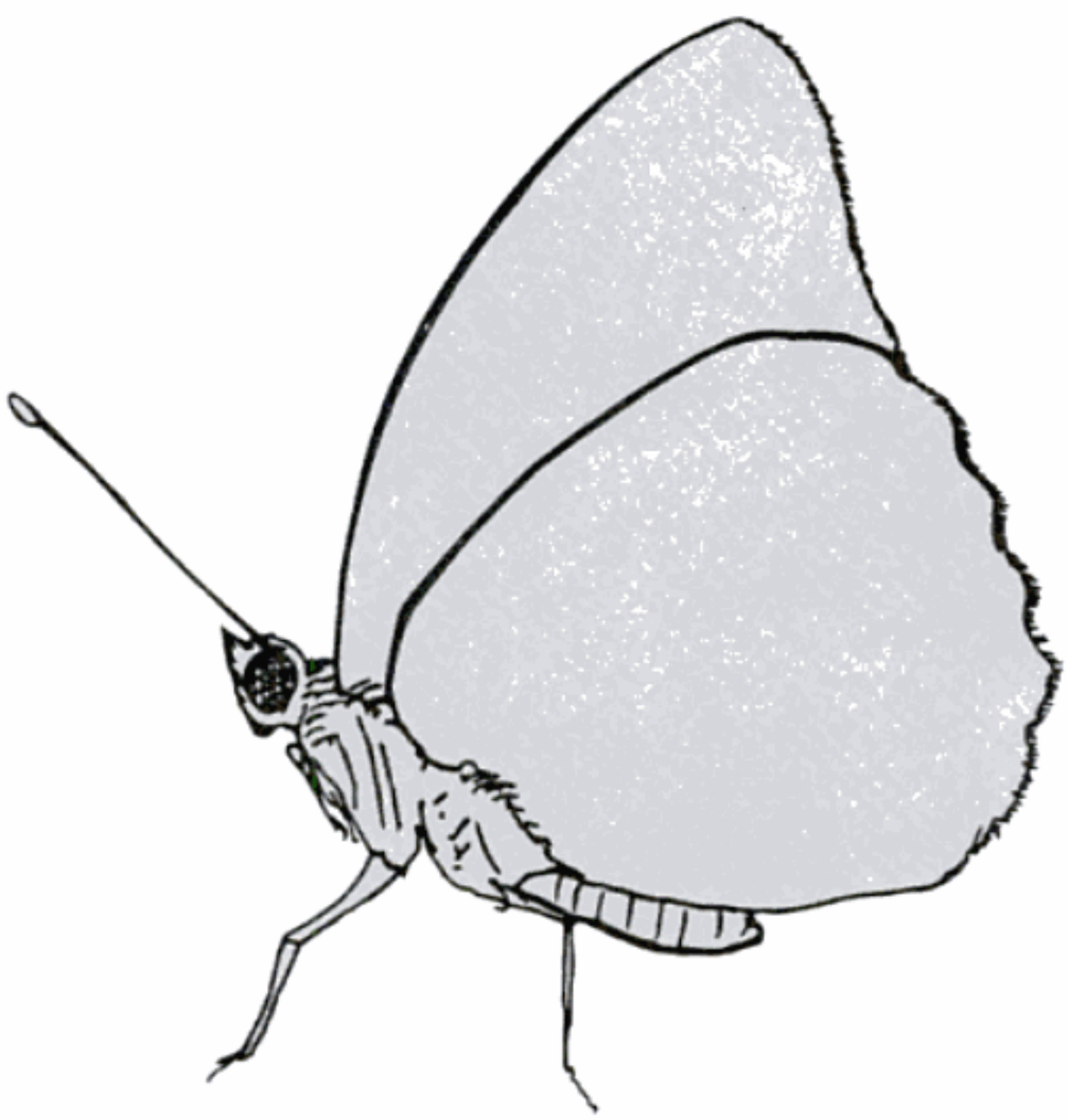

5.3 Family Nymphalidae

Brush-Footed Butterflies

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Family Nymphalidae

Butterflies of the family Nymphalidae are popularly known as the "Brush-footed butterflies". It is a diverse family and now includes many subfamilies, for example, Acraeinae, Amathusiinae, Danainae and Satyrinae, which were earlier treated as distinct families. The fore legs of these butterflies have diverse structures and may be reduced and functionless as walking legs in either the males or the females, or both. However, they are never fully developed and completely functional as in other butterfly families. They are sometimes covered with long, dense scales, forming brush-like stubs, hence the family name.

Many subfamilies that constitute this family, for example, Brassolinae (South America) and Amathusiinae (Indo-Australian tropics), are restricted to only one or two continents. However, some larger subfamilies, for example Satyrinae and Nymphalinae, are widely distributed around the globe with species present on almost all continents. This makes it the world's largest and most widespread butterfly family, along with Lycaenidae, with about 6, 000 species. India has over 520 species. Thus, the Brush-footed butterflies make up about a third of the global as well as the Indian butterfly fauna. There are approximately 100 species in peninsular India, but their diversity peaks in the Himalayas and northeast India.

The Brush-footed butterflies are so diverse in their body form and habits, that generalizations are difficult at the family level; except that the pupae of all the species are suspended. Therefore, they are discussed below at the subfamily level. Although all the subfamilies which are represented in peninsular India are mentioned, more information is given for only those with a considerable number of species in this region.

1. **Subfamily Amathusiinae** It is represented in peninsular India by a single uncommon species, the Southern Duffer (*Discophora lepida* Moore). Earlier, this belonged to family Amathusiidae, but is now sometimes placed in the subfamily Morphinae, which includes the dazzling blue south American *Morpho* butterflies.

Southern Duffer female UP

2. **Subfamily Satyrinae** This includes the Evening Browns, Bushbrowns, Rings and Palmflys, with about 30 species in peninsular India. These are mostly small to medium-sized crepuscular butterflies, flying mainly during early and late hours of the day, except the Rings, which are active throughout the day. They show distinct wet and dry season forms and most species are active in all the seasons.

   The sexes are usually alike except that the males possess sex brands. The scent-producing brands of Bushbrowns and Palmflys consist of erectile tufts of hairy scales and patches of scent scales. These are arranged on both the fore wings and hind wings and rub against each other. The female Palmflys mimic the Tigers, and therefore they look very different from the males.

   A majority of the species frequent openings, either in the forests or in the open habitats, a few occur only in the dense undergrowth of tall forests.

   The Rings may feed from flowers, but others derive nourishment from animal

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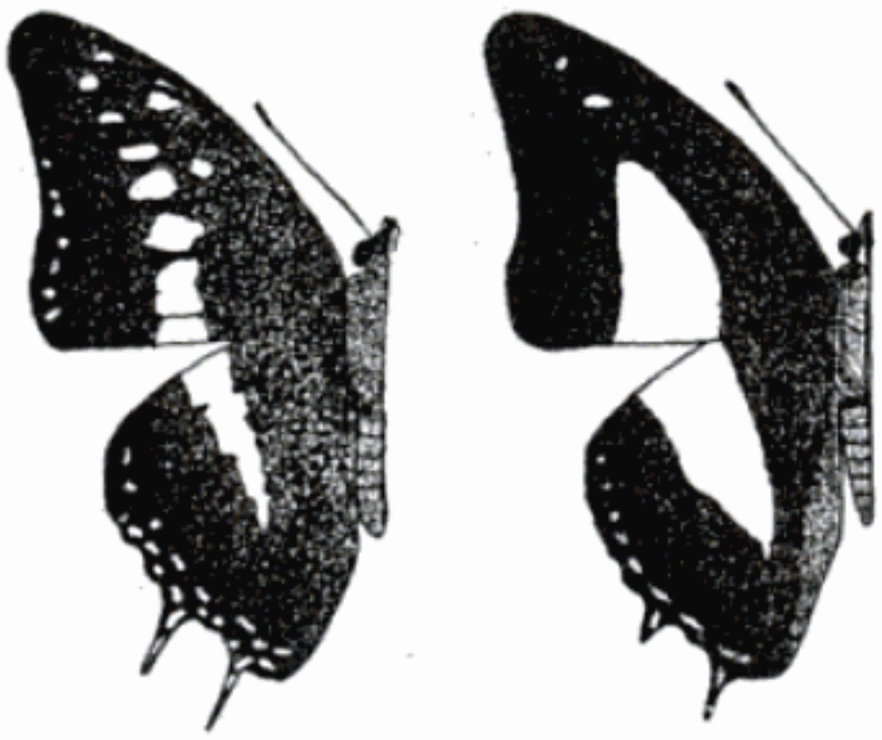
droppings, wet soil, tree sap and rotting fruits. Their caterpillars feed on grasses, bamboos and a few feed on palms.

Their eggs are round, white and finely ornamented. The caterpillars are long, slender and roughly spindle-shaped. They possess two long horns or conical projections on the head and a bifurcated tail. They usually feed at night and rest during the day on the undersides of the leaves of their host plants.

3. **Subfamily Charaxinae** The Rajahs and Nawabs constitute this subfamily. They are large and very powerful butterflies, with massive thoraxes and narrow, pointed fore wings. Five species occur in peninsular India, which are usually rare. However, the Black Rajah (*Charaxes dolon* Fabricius) and the Common Nawab (*Polyura athamas* Drury) (Plate 13, no. 77) may be locally common. The former is fairly common in Tadoba Tiger Reserve in central India and the latter in and around Borivili National Park near Mumbai. Their caterpillars are beautiful green creatures, with large head shields and white and yellow markings on the body.



Black Rajah UP *Common Nawab UP*

4. **Subfamily Nymphalinae** This is a very heterogeneous subfamily, which includes such diverse groups as the Sailers and Sergeants, Fritillarys, Painted Lady and Admirals, Pansys, Castors, Eggflys and Oakleafs. Many of these groups, for example, the Castors, Fritillarys, Sailers and Sergeants, are sometimes placed in separate subfamilies of their own. In all, there are 46 species in peninsular India.

The body form of these butterfliess are varied, but many of them have large, strong thoraxes and relatively short or narrow abdomens. They are usually strong fliers. The Castors have longer and thicker abdomens and they are weak fliers.

The sexes are more or less similar in markings, except in the mimetic species. The males usually lack scent scales.

These species feed on virtually all the resources reported for butterflies: nectar, tree-sap, rotting vegetable matter, animal droppings and wet soil.

The caterpillars are spiny and usually dark in colour. The spines are branched and the head also has spiny projections or horns.

There is at least one species account from each group of this subfamily in this book. The group-specific information not given in this section may be found in the respective species accounts.

5. **Subfamily Heliconiinae** These are the famous 'passion vine butterflies' of the American tropics. Two species occur in our area—the Cruiser and the Tamil Lacewing. These two species were earlier placed in a different subfamily, but now are probably more appropriately included in this subfamily. The larval host plants are the "passion vines": *Passiflora* and relatives.
6. **Subfamily Acraeinae** This is mainly an African group, with approximately 250 species occuring there. It is represented in India by only two species: the Yellow Coster (*Acraea issoria* Hübner) of the Himalayas and the Tawny Coster of peninsular India. It is sometimes treated as a group in the subfamily Heliconiinae. The eggs are laid in batches of several dozens. The species are unpalatable and there are no mimics in India.
7. **Subfamily Danainae** In peninsular India there are six species of Tigers, three

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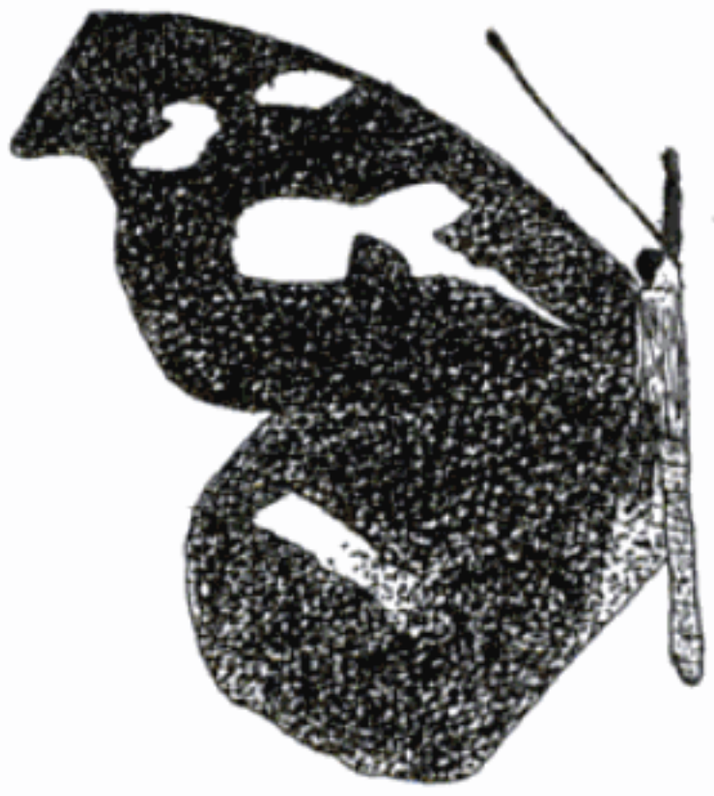
Crows and one Tree Nymph, adding up to ten species in this subfamily. This is a very well-known and omnipresent group, which includes the world famous Monarch butterfly of the United States, familiar even to the casual reader. It is also amongst the most studied groups of butterflies. These butterflies have been and are being studied for their habits of long-distance migrations and association with plants that are rich in unpalatable alkaloids. Because of their unpalatability, they are mimicked by a diverse array of species, especially those from other subfamilies of Nymphalidae. More information on migration and mimicry in this group is given in the sections 2h. Migration and Local Movements and 2k. Adaptations to Escape Threats: Unpalatibility and Mimicry.

The Tigers and Crows have long abdomens, short thoraxes and broad wings and therefore they are not suited to flying fast. Their unpalatability also makes flying fast unnecessary. However, they are tenacious fliers and can cover very long distances in a single flight. The sexes look similar, but the males have specialized scent scales and brands. They also possess long 'hair pencils' at the tip of the abdomen, which are always retracted into the abdomen except when they are being used to spread scent scales (Plate 1, no. 5).

The Tigers and Crows inhabit different habitats and altitudes, but mostly deciduous, semi-evergreen and evergreen forests. However, they usually prefer openings and edges in these forests. The Tree Nymphs are also found in the shade of dense evergreen forests.

The eggs are tall, broad and narrow at the apex, usually white in colour. The caterpillars are cylindrical and smooth. The caterpillars of the "Blue" Tigers (for example the Blue, Dark Blue and Glassy Tiger) possess two pairs of fleshy tentacles, those of the "Tawny" Tigers (for example the Plain and the Striped Tiger), three and the Crows and Tree Nymphs, four. They feed on plants of the families Apocynaceae ("oleander" family), Asclepiadaceae ("aak" family) and Moraceae ("figs" family). The pupae are attractive, marked with golden and silvery bands and spots and those of the Crows are entirely golden.

8. **Subfamily Libytheinae** This subfamily is characterized by very long labial palpi, which protrude far in front of the face, looking like beaks, hence the common name for these butterflies—"The Beaks". Only two species represent this group in peninsular India: the Common Beak (*Libythea lepita* Moore) and the Club Beak (*L. myrrha* Godart). Both are very local and rare.



Common Beak UP

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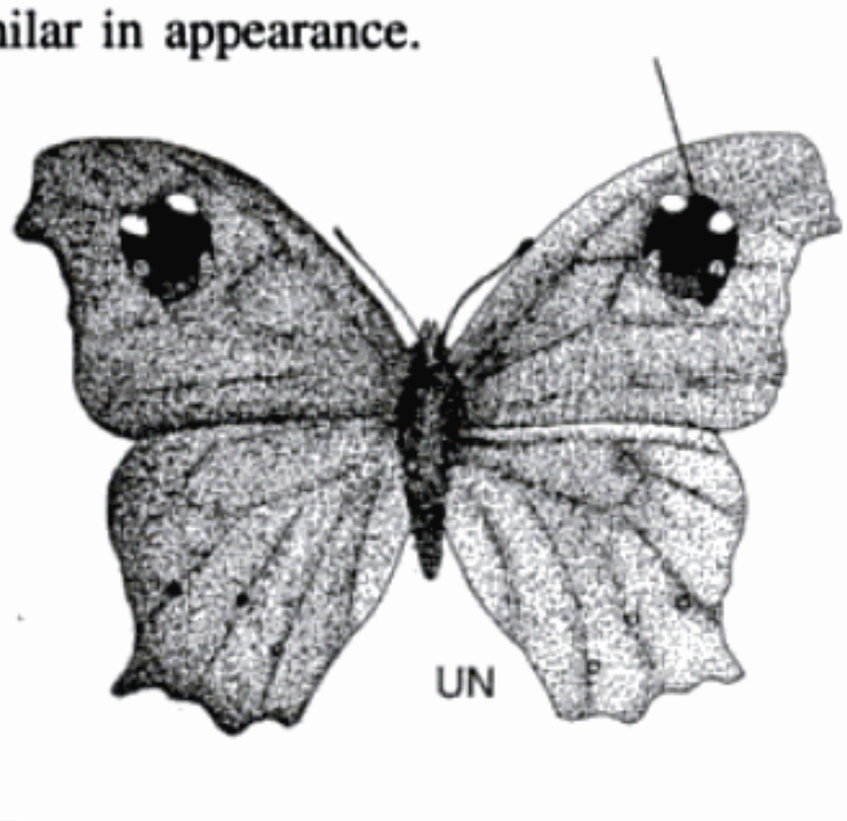
26. Common Evening Brown

(Plate 13, no.78 and Plate 14, no. 79)

Scientific Name *Melanitis leda* Linnaeus

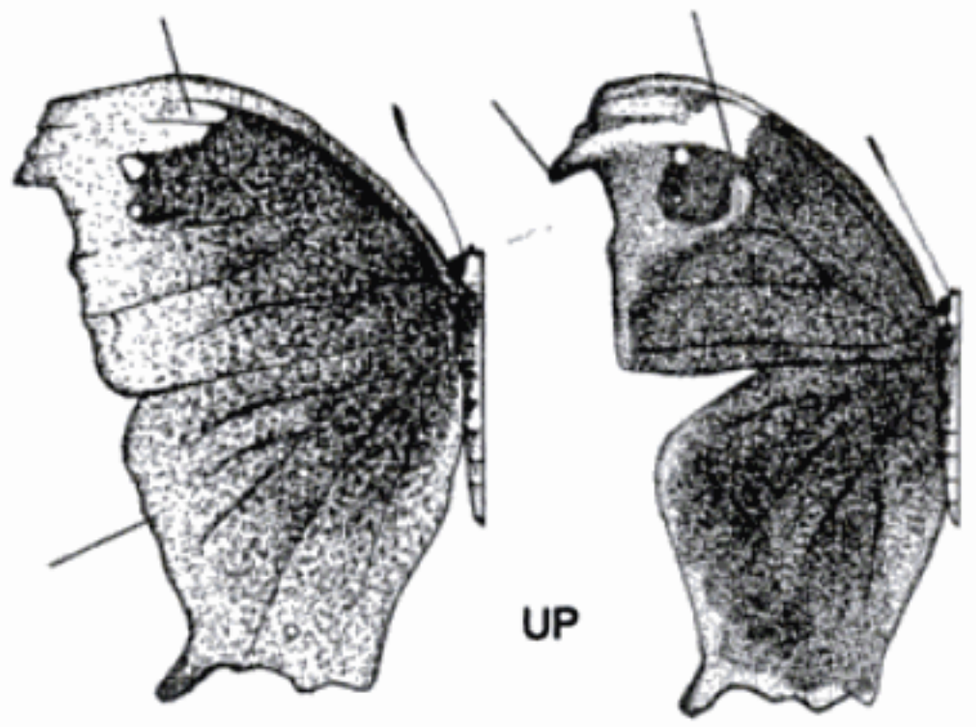
Field Characters Wingspan: 60–80 mm. This is an inconspicuous brown butterfly. The upperside is dark brown with an eye-spot and a white 'pupil' on the fore wings surrounded by orange patches (especially in the dry season form). The underside is variable. This butterfly rests camouflaged among fallen leaves on the forest floor and hence is marked in such a way that the colour and pattern on the wings merge with the surrounding leaf-litter. In the wet season forms, the wings are marked with small eye-spots and black streaks and the ground colour is yellowish-brown. The dry season forms are pale brown with a few obscure markings. The apex of the fore wing is produced and angular only in the dry season forms. The sexes are similar in appearance.



Dry season form Wet season form

Medium-sized to large, brown with an eye-spot, but varying markings

Similar Species Two other species, the Dark Evening Brown (*M. phedima* Stoll) and the Great Evening Brown (*M. zitenius* Herbst), are similar in appearance but relatively rare. The former has the eye-spots on its fore wings noticably reduced and the wings bordered grey. The latter has acutely angular fore wings ending in a sharp point. The undersides of both these species are similar to that of the Common Evening Brown.



Dark Evening Brown ***Great Evening Brown***

Status, Distribution and Habitat This is one of the few butterflies that are omnipresent throughout India and have a wide habitat choice. It is found in dense evergreen forests, deciduous forests, scrub and savannahs, as well as neglected, shaded places in urban gardens. However, it is not likely to be common in extremely dry and open areas. In recently cleared narrow forest belts and edges this may be sometimes the most abundant species and perhaps the only one on the floor of the closed, thick evergreen forests. It is widely distributed in the middle-east, south and southeast Asia and the Australian region.

Habits An important characteristic of butterflies is their diurnal habits. However, this butterfly is an exception. As the day dies out, it comes out of its hiding place and flies about in an unsteady manner. Being crepuscular, it is often attracted to electrical lights and

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such is the attraction that it will stubbornly return to the light even after repeated attacks by predators, such as the geckos.

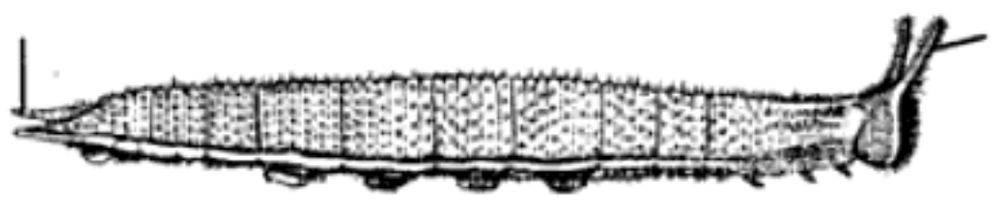
Flower nectar, the most familiar food of butterflies, does not usually interest it. Instead, it searches for alcohol-rich fruits and tree-sap. Fallen and rotting fruits attract this butterfly and it can be baited by wine, toddy, etc. It also flocks around wounded patches on tree trunks. On a small wound in the bark, as many as 7–8 individuals may be seen feeding on oozing tree sap, sitting shoulder to shoulder without quarrelling. At such promising and tempting spots, it may take to diurnal activity. It may occasionally feed from flowers.

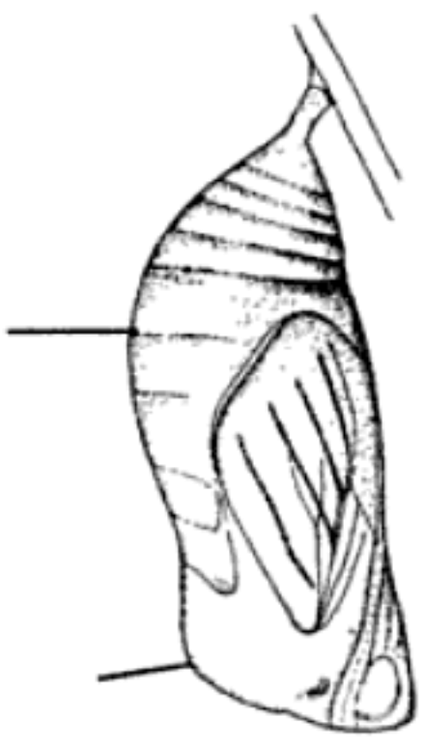
It keeps close to the ground and never flies high up, except very rarely when visiting a wound in the bark of a tree. It shuns direct light and brightly-lit places, and never basks. During the day it keeps motionless in the shaded undergrowth, among root complexes along cool forest streams or on leafy ground. There it rests bent on one side, as if unbalanced, so that it is hard to spot among the fallen sticks and dead leaves. When an unknowing predator approaches it, it rushes out and darts a few metres away, vanishing into the denser undergrowth. This leaves the intruder confused. Immediately after landing, it may open its wings and turn around a few times to display eye-spots on the fore wings, but then rests motionless.

Reproduction The female may be careless while laying eggs. It lays them not strictly on its larval host plant: the grasses, but also on small neighbouring plants, the ground or even dead grass-blades. Since grasses are abundant everywhere, the caterpillar finds its way through the vegetation to its host plant. The egg is round, white and laid singly on the underside of a grass-blade. The caterpillar is a bright grass-green, spindle-shaped, with thin white lines on the sides and difficult to locate in a thick bunch of luxuriant grass. Its body is covered with white conical tubercles, each of which bears a visible white hair. When it is young, its head is black, it later develops a green face and finally the black of the head is reduced to a stripe on the cheek, which runs from near the jaws to the base of the horns. A white stripe of equal breadth is next to this black one. Its two horns are maroon-red and very hairy. On the dorsal side of the abdominal tip are present two pointed projections that are as long as the horns on the head. The caterpillar remains stretched and motionless under the grass-blade in the daytime and feeds mainly at night.

Before pupation the caterpillar wanders away from the grass blade on which it has fed. It pupates close to the ground, on the underside of the support such as a grass-blade or stem. The pupa hangs freely, attached to the support by means of claspers. It is green, long and slender, with a small hump on the thorax.

The caterpillars are attacked by Ichneumon wasps and flies and after death the infected pupae turn dark brown.





Length of caterpillar: 39 mm. Length of pupa: 21 mm.

Larval Host Plants The caterpillars feed on various species of grasses and they do not seem to be rigidly restricted to a certain species. The grasses so far recorded include *Apluda* spp., *Cyrtococcum* spp., *Eleusine* spp., *Oplismenus compositus, Oryza sativa, Panicum* spp., *Sorghum* spp. and *Zea mays*.

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The caterpillars also feed on species of other grass genera. This shows that although the females may have egg-laying preferences, the caterpillars are not particularly selective in their diet in terms of species of grass used. However, they probably choose between amount of silica and carbohydrates, etc. in the grass-blades.

Suggestions for Student Projects In recent years considerable research has been done on seasonal variation in colouration and form, mainly on butterflies of the temperate region. A positive correlation between wing pattern, amount of black scaling per unit area on a butterfly's wing, average day temperature and survival rate of the butterflies has been established.

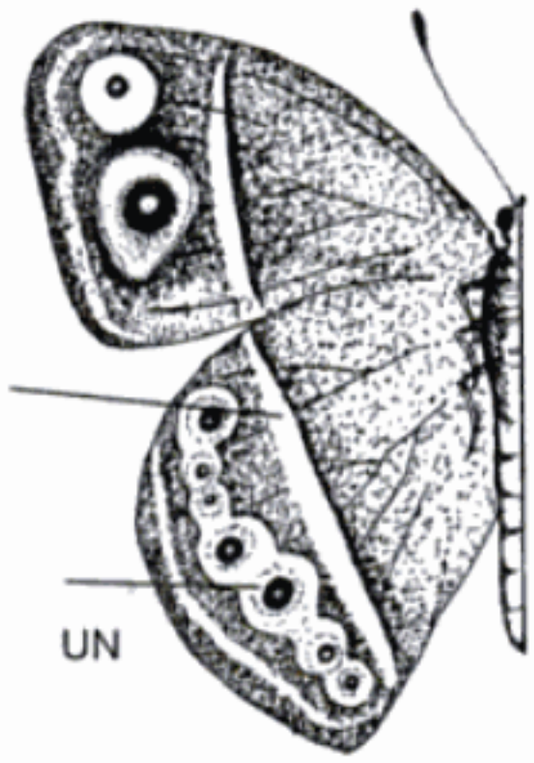
The Common Evening Brown shows very striking differences in its dry and wet season forms. Therefore, it presents an ideal case for studies on variation in colouration and form. Monitor the local Common Evening Brown populations for dry and wet season forms, their relative proportion across seasons and the average day temperature. Which range of temperature shows the maximum number of dry (or wet) season forms? Are dry and wet season forms always distinct or do they show intermediate wing patterns that gradually change with the temperature range?

27. Common Bushbrown

(Plate 14, no. 80 & 81)

Scientific Name *Mycalesis perseus* Fabricius

Field Characters Wingspan: 38–55 mm. This is a medium-sized, brown, inconspicuous butterfly. There is an eye-spot on the upperside of each fore wing at the outer margin. The underside varies with the seasonal forms. The wet season form has a white line running from the leading margin of the fore wing to the tornus of the hind wing. A series of eye-spots (black spots with white centres) is enclosed in the area between this line and the wing margin. The central spot in this series stands out towards the wing margin, but the others are in a line. In the dry season form this white line is usually absent, but it may be represented as a pale brown or thin white line. The black eye-spots are reduced to mere indistinct dots. The female and male look identical in colouration and markings, but the latter has small, black, hairy brands in the region of overlap between the hind and fore wings.



Medium-sized, dull-brown butterfly with or without eye-spots and white band

Similar Species In all, 11 species of Bushbrowns occur in peninsular India. The Glad-eye Bushbrown (*M. patnia* Moore) (Plate 14, no. 83) has a large round white area with an eye-spot on the lower part of each fore wing on the underside, but its other markings are very variable. It is found in deciduous forests and bamboo jungles. The White-bar Bushbrown (*M. anaxias* Hewitson) (Plate 14, no. 82) has a white band near the apex of each fore wing. It prefers dense

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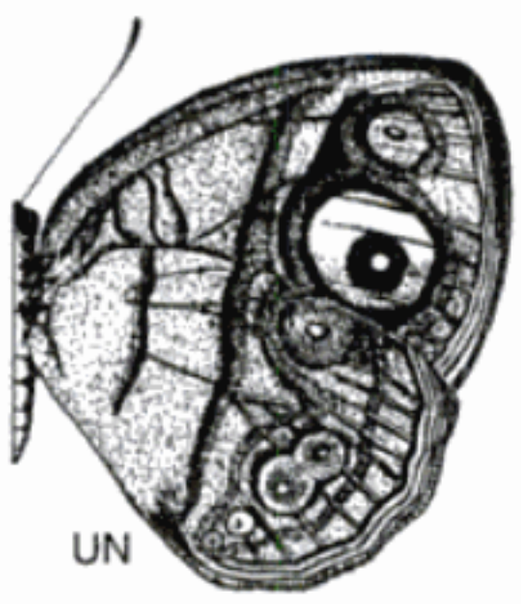
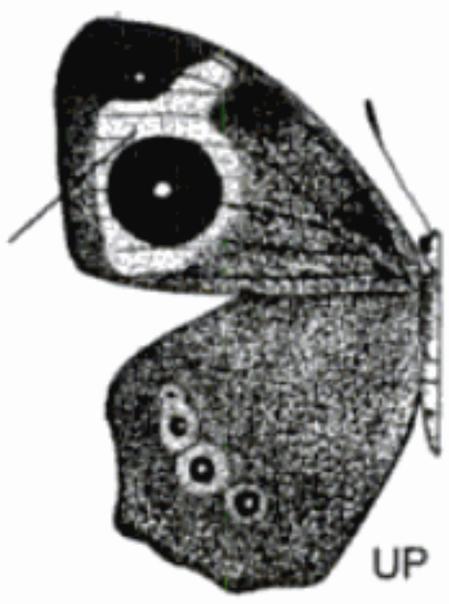
evergreen forests where it can penetrate deep into the interior. The Red-eye Bushbrown (*M. adolphei* Guérin-Ménéville) has a reddish-brown ring around the eye-spot on the upperside of the fore wing. The Red-disc Bushbrown (*M. oculus* Marshall) (Plate 14, no. 84) has a broader reddish area around this ring. The former is endemic to montane habitats in the Nilgiris, the latter, to highlands south of the Palghat gap in the southern Western Ghats. The other species are very similar to the Common Bushbrown and distinguishing between them is difficult for amateurs. The commonest of the species are the Dark-brand Bushbrown (*M. mineus* Linnaeus) and the Tamil Bushbrown (*M. subdita* Moore), both of which have all the eye-spots in a series on hind wing in a line. The Nigger (*Orsotrioena medus* Fabricius) (Plate 15, no. 85) is a similar species from a different, but allied genus and shares the habitat and the habits with the Common Bushbrown. In this species the white band is very broad and only five distinct spots – two on fore wing and three on hind wing – are present.

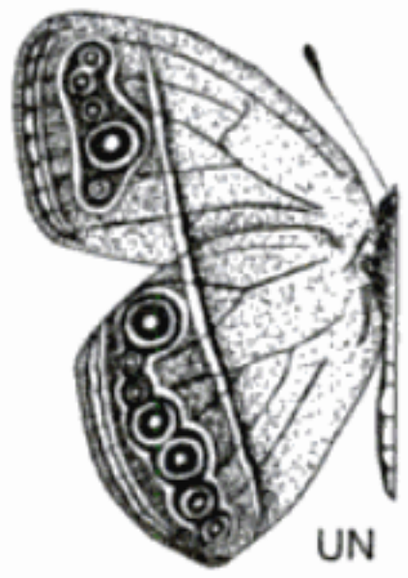
White-bar Bushbrown



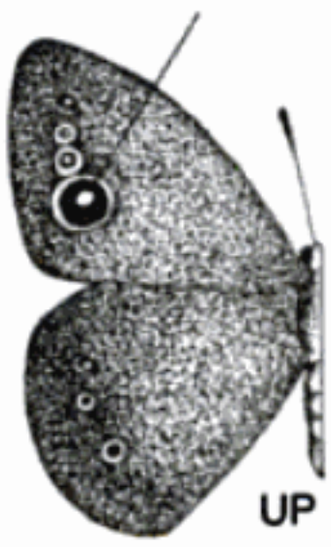
Glad-eye Bushbrown



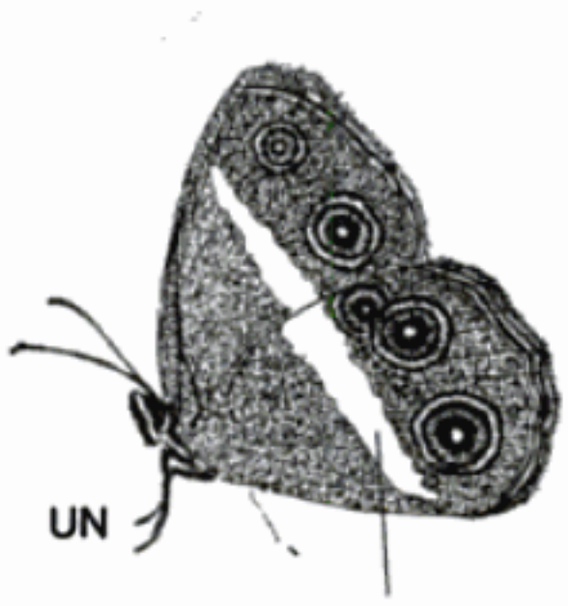
Red-disc Bushbrown



Tamil Bushbrown



Red-eye Bushbrown



Nigger

Status, Distribution and Habitat This is a widely distributed butterfly that ranges from being common to very common wherever it occurs. It inhabits deciduous, semi-evergreen and evergreen forests, but is commonest in bamboo forests. It also frequents open areas, such as scrub and savannahs, if shade is available. It is abundant more or less throughout the year, with little variation in numbers in the evergreen forests, but more frequent during the monsoon in the deciduous forests. It occurs in Sri Lanka, India and southeast Asia.

Habits The flight of the Bushbrown is somewhat comical. It is disturbed now and then by jerky up-and-down movements that are typical of puppetry. Thus, it proceeds in an unstable manner and always keeps close to the ground. It goes neither inside dense, dark undergrowth nor away from it, but goes round and round the shrubs so that it is difficult to follow it for long.

Its preferred food, tree-sap and rotting fruits, is similar to that of the Evening Browns but in addition it is also fond of cow- and gaur-pats. It also visits other mammalian herbivore droppings, but not usually those belonging to omnivores and carnivores. Such droppings are a much sought-after resource. Therefore once a Bushbrown settles to feed, smaller moths and flies, which compete with it for the food, cannot easily disturb it. In fact, tiny fruit-flies (*Drosophila*) are tolerated to such an extent that they sit on its antennae

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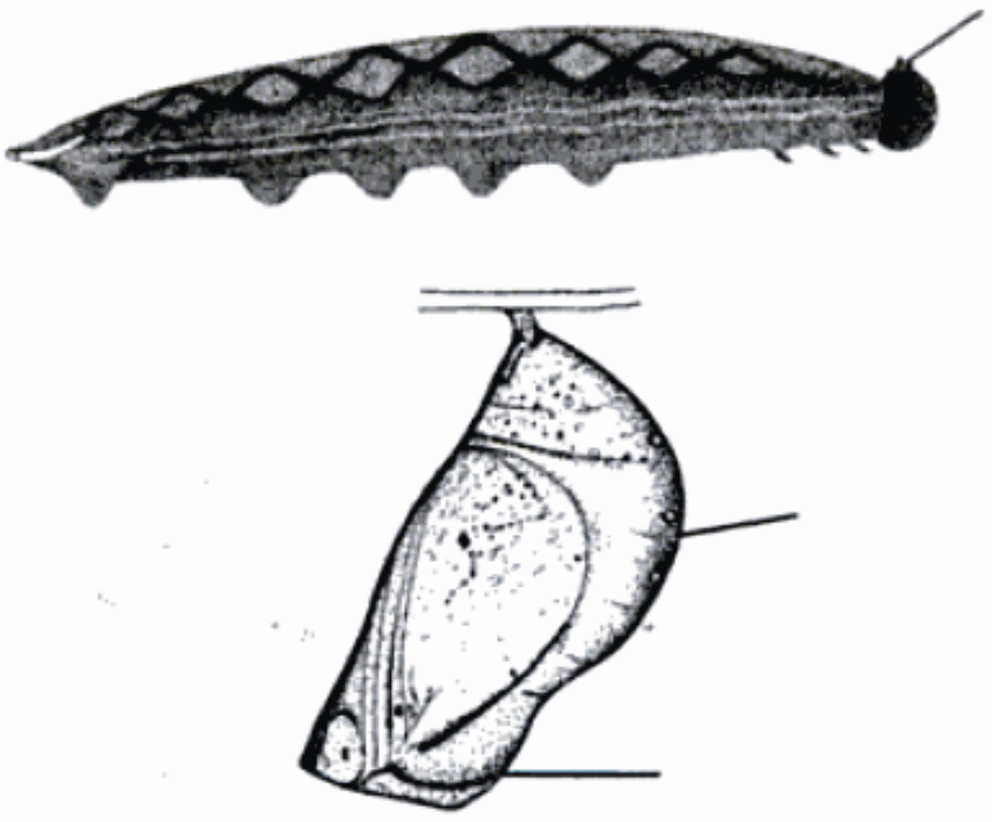
and labial palpi, two important sense-organs of the butterflies.

It is rarely seen active because of its crepuscular nature. Unlike the Evening Browns, it is usually not attracted to electrical lights.

On cloudy days or in the mornings it basks while perched on grass or leaves, but always close to the ground. It spreads its wings flat to the substratum, so that the eye-spots on the fore wings are prominently visible.

Reproduction The egg is round and dirty white, with extremely small pits on the surface, which are visible only under a microscope. The caterpillar stays under the blade of grass, lies stretched on the mid-rib and usually on the hanging end of the blade. It eats the grass-blades from the sides, but never to any great extent and moves on from leaf to leaf. It is brown and spindle-shaped, with a pair of pointed anal processes and a pair of short, conical, thick horns on the head. The head is black or very dark brown, squarish, swollen at the cheeks and broadest at the jaws. The body is marked with large diamond-shaped dark spots. The pupa is dark green, long and slender, with pairs of yellow spots on the abdominal segments. The thorax and abdomen are strongly humped.

Larval Host Plants The caterpillars feed on the grasses in general, but region-wise specific records of grass species and genera are needed.



Length of caterpillar: 28 mm. Length of pupa: 11.5 mm.

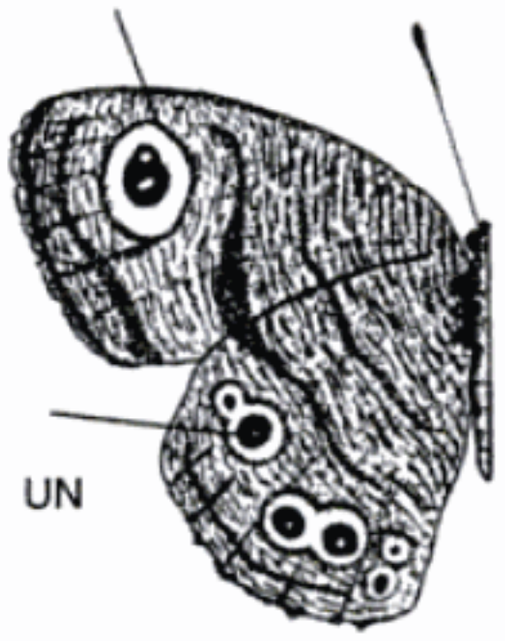
28. Common Five-ring

(Plate 15, no. 86)

Scientific Name *Ypthima baldus* Fabricius

Field Characters Wingspan: 30–50 mm. The underside is paler, whitish or faint brown, with brown streaks. On the fore wing is a large eye-spot enclosed in a golden-yellow ring. A 'U'-shaped dark marking encloses this eye-spot. These markings are present in both the wet and dry season forms. On the underside of the hind wing 6 eye-spots, in three pairs, are present. These eye-spots, in the dry season form, are represented by dots. A large eye-spot on the upperside of each fore wing is distinct when the butterfly is basking. The male and female are similar in appearance.

Similar Species In peninsular India, 7 species of Rings occur. After some practice these species are easy to identify in the field. They are roughly classified into three groups, namely, the Three-ring, Four-ring and Five-ring, based on presence of eye-spots in particular wing areas



Common Five-ring

Small, pale brown with an eye-spot and striations

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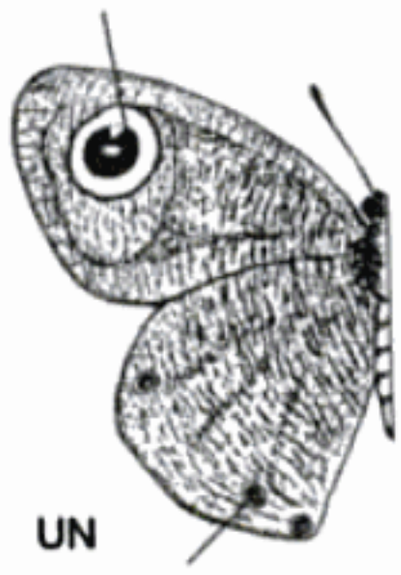
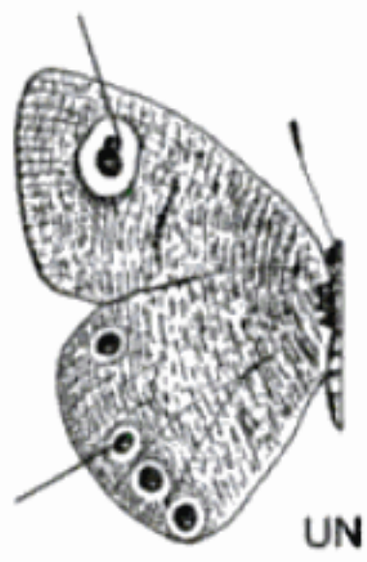
on the underside of the hind wing. For identification keys for this genus, refer to Wynter-Blyth (1957) and Evans (1932). Among these species the White Four-ring (*Y. ceylonica* Hewitson) is distinct due to its white hind wing. The Nilgiri Four-ring (*Y. chenui* Guérin-Ménéville) is endemic to the montane grasslands in the north of the Palghat gap, and the Palni Four-ring (*Y. ypthimoides* Moore) to the grasslands on the south of the Palghat gap in the southern Western Ghats. These are dark brown on the underside. The Common Three-ring (*Y. asterope* Klug) (Plate 15, no. 88) and Common Four-ring (*Y. hübebneri* Kirby) (Plate 15, no. 87) are two of the other common species, both of which are found in drier and more open areas as compared to the Common Five-ring.



Common Three-ring



Common Four-ring

Status, Distribution and Habitat It is very common in dry and moist deciduous forests and on forest paths or other openings in semi-evergreen and evergreen forests. It avoids dense vegetation in all habitats and is more plentiful in secondary forests. It also occurs in shrublands, but not as commonly as in the forests. It is active throughout the year, although in drier areas it may be rare in the summer and restricted to nullahs and valleys. Otherwise in the monsoon the wet season form and in the winter and summer the dry season form are very common. It is distributed throughout the Indian subcontinent, except in Sri Lanka, and to the east all the way to Japan and south to southeast Asia.

Habits In the morning the Five-ring basks with its wings spread out halfway, revealing the large eye-spots on the fore wings. Once it is warm enough to become active, it moves about in short bursts of a dancing, "hopping" style of flight. It is a modest flier and does not go far without halting a few times *en route*, always keeping close to the ground. Individuals from central Western Ghats, while sitting on the grass or fallen leaves, sometimes draw the fore wings between the hind wings to hide the yellow-ringed eye-spot on the fore wing, which is the only ornament this dull butterfly wears.

It visits wet soil, especially in the summer or on hot days in other seasons. It is also a frequent visitor to flowers, unlike most of other Browns. Small herbs and shrubs, especially favourites such as *Adelocaryum, Cipadessa fruticosa, Tridax, Clerodendron serratum*, when flowering, are crowded with dozens of individuals. It spends a long time on the flowers, probing deep in each flower and occasionally flashes the eye-spots on the fore wings with a rather prolonged flick of the wings.

Reproduction The female lays its eggs singly, usually on the underside of a grass blade. The egg is round and white with a green tinge. It looks smooth, but is covered with hexagonal cells that are easily visible under a microscope. The caterpillar is spindle-shaped with a flat belly. The head is reddish-brown with a round swollen face and a central depressed line. The abdominal tip has two reddish-brown, conical, pointed projections. The body is yellowish-green or light brown with a few faint longitudinal lines on the back. The caterpillar rests on the underside of a hanging portion of the grass-blade and eats the edges up to the mid-rib.

Pupation takes place on the underside of a grass-blade or a similar object. The pupa is similar in shape to that of the Common Bushbrown, but more angular. It is yellowish and sprinkled with brown dots and spots. There are minor ridges on the abdomen, which are dark brown.

Length of caterpillar: 25 mm. Length of pupa: 15 mm

Larval Host Plants Various species of grasses are the host plants, but records of site-specific grass species are needed.

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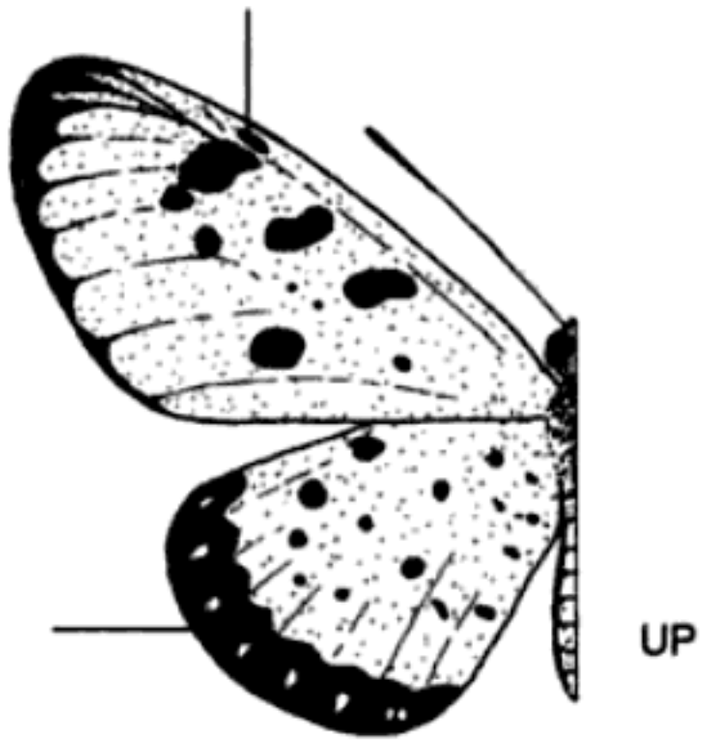
29. Tawny Coster

(Plate 15, no. 89)

Scientific Name *Acraea violae* Fabricius
(Old: *Telchinia violae* Fabricius)

Field Characters Wingspan: 50–65 mm. This butterfly is unmistakable due to its lazy flight, distinctive wing shape and bright tawny-red colouration. The fore wings are long but broad and rounded at the apex. The hind wings are round. Both the pairs of wings are tawny-red with a black border, which is broader on the hind wings and encloses a series of white spots. The wings are marked with black spots. The thorax is small, the abdomen is long and narrow. The sexes look similar.



Small, tawny with black markings

Status, Distribution and Habitat This species belongs to a predominantly African group. In Africa about 250 species occur, but in peninsular India only one species: the Tawny Coster, occurs wherever its larval hosts *Passiflora* spp., the passion-flower plants, grow. The butterfly avoids shade and dense vegetation but frequents openings in all vegetation types, including clearings in evergreen forests. It is common in gardens and its caterpillars may infest passion flower plants, around which it may be abundant. Its occurrence is seasonally unpredictable, but it is found throughout the year. It is restricted to the Indian subcontinent.

Habits This is among the boldest fliers in India. Its flight is very slow but long-sustained, with weak wingbeats. It keeps within 3 m from the ground. The species is protected in the same manner as the Tigers but is much more confident of its unpalatability than the latter. The Tigers, when disturbed, fly fast and erratically. The Tawny Coster, however, flies unaffected in the same careless fashion even after attacks from its predators. When caught it feigns death and exudes an obnoxious yellowish fluid from special glands situated in the joints of the legs. This fluid is nauseous. Furthermore, the butterfly has a tough skin and is hard to kill. This helps it to survive a few pecking attempts by a bird, or powerful bites of a lizard. Once left alone, the 'dead' butterfly takes off immediately.

Flowers are the sole source of food for this butterfly. It flies close to the undergrowth and herbs and seeks flowering plants in this range. It does not vist flowers hurriedly, and often the individuals may be seen sitting on the same flower for a long time. While feeding, the butterfly folds its wings over its back or moves them slowly. They are also used for balance, especially when feeding from the pendant flowers of herbs, such as that of *Tridax*.

It basks with its wings closed or spread flat and usually sits within a metre from the ground while doing so.

Reproduction The eggs are laid in batches of 20 to 100. The egg is yellow, slightly elongated and tall. The caterpillar is a reddish-chocolate brown on the upperside and yellowish white on the underside. The head is reddish. The body segments have a number of branched spines. The caterpillars from the same batch live gregariously and destroy branch after branch. These caterpillars are often a menace to the passion-flower plants in gardens, since they usually devour all the edible tissues of the plant. Once the adult

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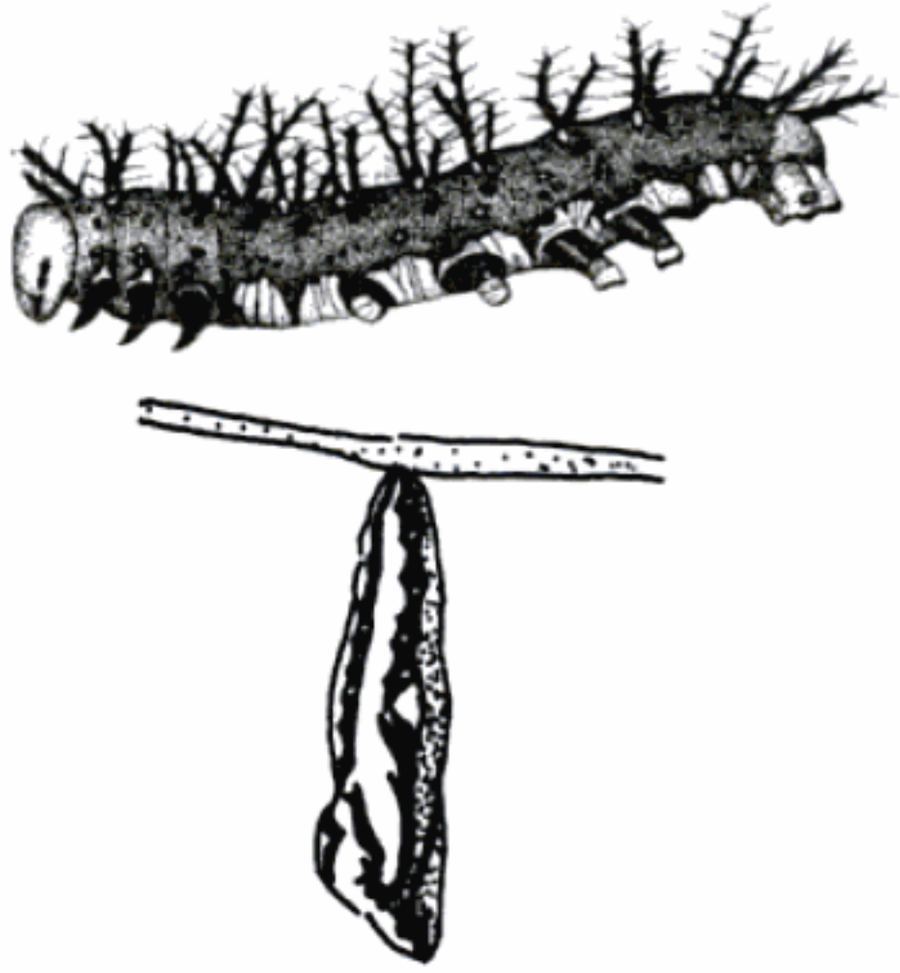
butterflies find the plant to lay eggs on in the garden, nothing can restrain them from doing so. Spraying pesticides is one option, but it is only temporarily effective. Once the poison is washed off, the females return. The caterpillars, like the adults, are equipped with a foul-smelling yellow fluid that repels predators. Only a few parasitoids parasitize this species but these can kill a large proportion of the larval population. Apart from parasitoids, the strongest force that controls the population seems to be intra-specific competition for food.

The pupa is white with black lines, spots and red markings. It is elongated and suspended freely from the support. It is amongst the most beautiful and boldly-marked pupae of aposematic species from India. The newly-emerged adults stay close to the host plant on which they had been feeding in the larval stages and seek mates there. Often, the females do not take the trouble to find another host plant and thus the same plant supports generation after generation of this butterfly.

After mating, a hard pouch develops at the abdominal tip of the female. This is a kind of seal that negates any further mating attempts.



Length of caterpillar: 21 mm, Length of pupa: 17 mm.

Larval Host Plants The host plants include *Adenia hondala, Passiflora edulis, P. foetida* and *P. subpeltata*: the "passion flowers" (Passifloraceae).

30. Tamil Lacewing

(Plate 21, no. 125)

Scientific Name *Cethosia nietneri* C & R Felder

Field Characters Wingspan: 80–95 mm. The male is a large and bright tawny butterfly with numerous black markings. There is a white band on the black apex of its fore wings. The borders of the wings are wavy and marked with white 'V's. The underside is variegated with red, blue, white and black. The female is similar but paler, its markings are larger and diffused.

Large, tawny with white band, black markings and wavy margin

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Similar Species The Striped or Common Tiger looks similar when on the wing, but prefers drier and more open forests. Its margins are not wavy and the markings are well-defined. The Danaid Eggfly female and the Plain Tiger lack the miscellaneous black markings on the wings.

Status, Distribution and Habitat The Tamil Lacewing is locally common in lowland, moist deciduous, semi-evergreen and evergreen forests, usually avoiding very dense patches. It is found throughout the year, but is more active from the pre-monsoon showers to the post-monsoon. The butterfly is endemic to Sri Lanka and the Western Ghats south of Maharashtra.

Habits This is a Müllerian mimic of the Striped Tiger. It flies slowly with rapid, but not strong, wing-beats. Its bright colour, prominent pattern and distinct odour that it emits when roughly handled, warn of its unpalatibility. It is hard to kill by the lepidopterists' orthodox method of thorax pinching and feigns death when handled. These traits are usually associated with unpalatable species.

It keeps low, close to the herbs and bushes and does not fly higher. It frequents open areas where sunlight is plentiful and thus basking places are easily available. It basks low down on herbs, with its wings pressed flat against the leaf, but also sometimes with its wings closed.

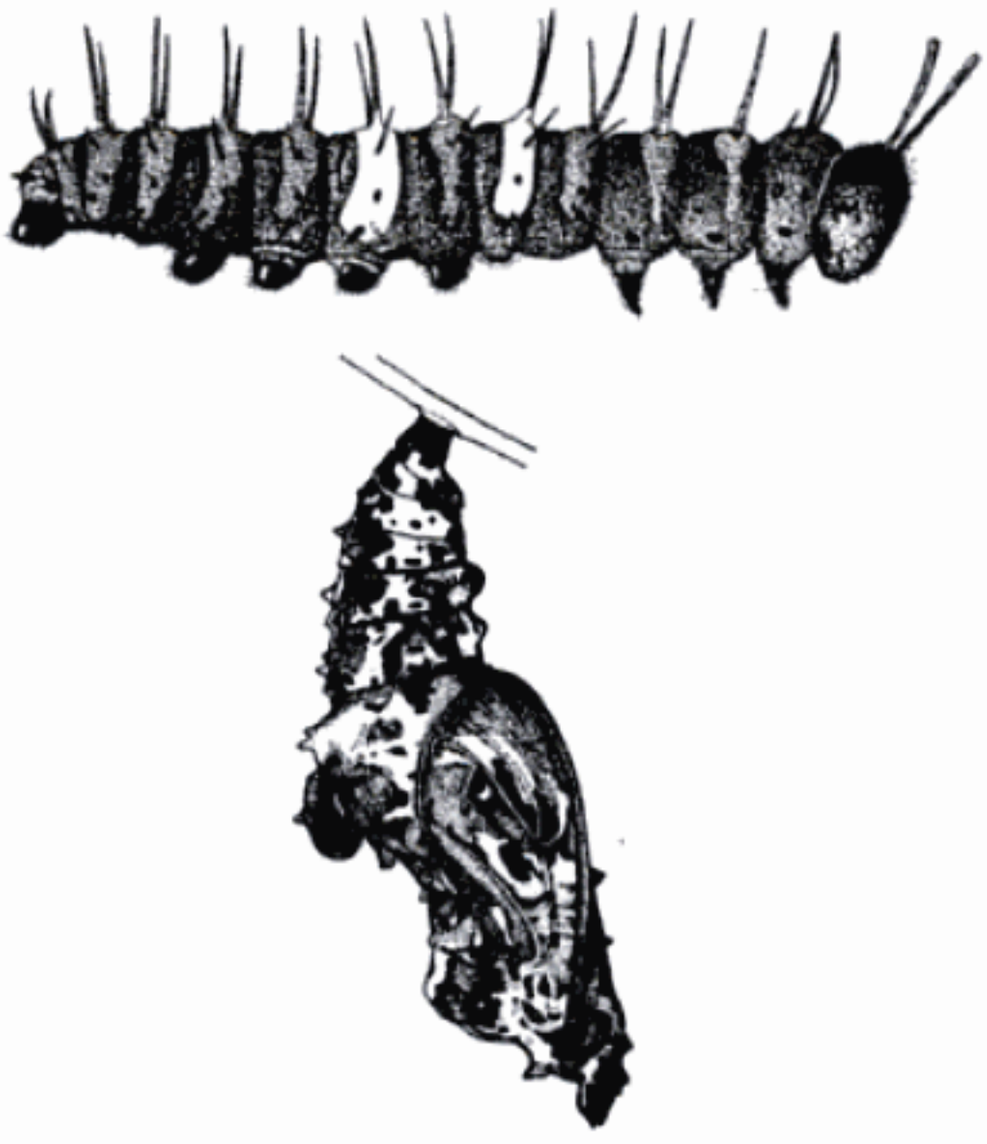
It visits flowers of mostly shrubs, occasionally herbs, and spends a very long time on individual flowers.

Reproduction The butterfly becomes more abundant after the first pre-monsoon showers, when the larval host plants grow new leaves. The females search for fresh and preferably very tender leaves and lay eggs in batches of 4 to 20 on the underside of the leaves. The eggs are lemon yellow, tall and broad, with vertical ridges on the surface. They resemble the Danaid eggs. The development inside the egg is slow and the caterpillar hatches only after a minimum of 6 days.

The caterpillars do not disperse after hatching and stay in the group with their clutch-mates, on the underside of the leaves. All their activities, namely, resting, feeding and moulting, are synchronized. They first scrape only the lower tissues of the leaves. Later, they eat up entire leaves, switching to new ones when the earlier ones are finished. They grow very rapidly and pupate about 15 to 18 days after they hatch from the eggs.

The caterpillars are completely black or dark brown when they hatch. With successive moults they turn more bright and gaudy. First they become a shiny, dark brown with broad lemon-yellow bands on the 6th and the 8th segments. Then they develop a series of crimson spots on all the segments, except the 6th and the 8th. These spots later form bands.The older caterpillars are thus chocolate brown alternately banded with crimson, with two yellow bands. They are spiny and horned.

The caterpillars often pupate in rows on a branch. The pupae are longish, with two twisted and spiny projections before the head and two flat expansions on the back. Many small, triangular tubercles make the pupal surface rough. The pupae are brown with three pairs of silvery-gold spots on the back.



Length of caterpillar: 42 mm. Length of pupa: 29 mm.

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The rest of the pupal surface is mottled with chocolate brown and white. The pupal stage lasts for slightly over a week.

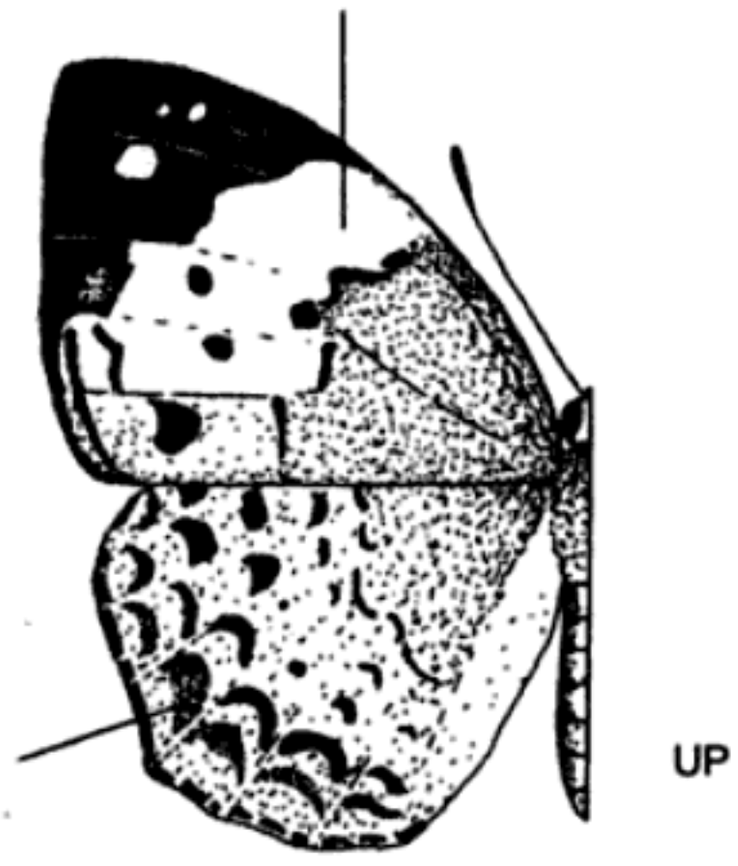
Larval Host Plants The caterpillars feed on a big climber: *Adenia hondala* (Passifloraceae), which grows in moist deciduous forests and clearings in semi-evergreen and evergreen forests. They are also reported to feed on cultivated species of passion flowers: *Passiflora edulis* and *P. subpeltata*. However, the females usually refuse to lay their eggs on cultivated varieties and the caterpillars refuse to feed, even if that means death by starvation.

31. Rustic

(Plate 15, no. 90)

Scientific Name *Cupha erymanthis* Drury

Field Characters Wingspan: 50–60 mm. The wings are ochre. Fore wing apex is black, with a broad yellowish or white central band. A few black spots are present on the hind wings. The underside is predominantly yellowish-brown, with small white and dark brown markings. The male and female look similar.



Medium-sized, ochre with black tip, yellow or white band

Status, Distribution and Habitat It occurs in high rainfall areas and in all types of forests. In evergreen forests, which is its preferred habitat, it frequents every sort of opening—tree-fall gaps, edges, paths and secondary growths. In the deciduous forests it is confined to riparian patches. It is common in these habitats and active throughout the year, but slightly less common in summer. It is distributed over southern India, Dehra Dun to the east and southwards to southeast Asia.

Habits The Rustic flies about in patches where there is dappled light, but perches in shaded places. The flight is uneasy with rapid wingbeats and the butterfly takes a long time before settling on an outstretched branch of a bush or a small tree. It is restless and changes places often. While in flight, it may be quite near the ground level or up to 40 m high in the tree canopy, but is more frequent at the shrub and small tree level. From here it takes short flights to feed on flowers in the canopy or other vegetation layers, but soon returns close to the ground. Flowers of shrubs and small trees, for example, *Leea, Premna, Meyenia laxiflora, Antidesma*, etc. attract this butterfly, as also *Lantana* and *Chromolaena*. The males sometimes visit wet soil. The females feed only from flowers and usually prefer more shaded places.

It basks in the sun with its wings three-quarters open. However, this is a wary butterfly and takes off if slightly disturbed. It is also pugnacious and chases away other butterflies that may fly around its perch.

Reproduction The reproductive behaviour, habits and appearance of the caterpillar and pupa of this species are similar to those of the Common Leopard. The caterpillar differs from that of the Common Leopard in having

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slightly longer spines. The head is light yellow, the belly is bluish-green and the dark brown body is marked with thin white lines on the back and the sides. The pupa has long, thin and straight processes, which are bent at the tips. There are golden, silver and bright red spots on the pupa. The Rustic and the Comman Leopard share the record for the quickest early stage development, from the egg being laid to the emergence of the adult taking just 21 days.

Larval Host Plants The caterpillars feed on small trees that grow in the openings or under slight shade, in the evergreen patches: *Flacourtia montana* and *F. indica* (Flacourtiaceae).

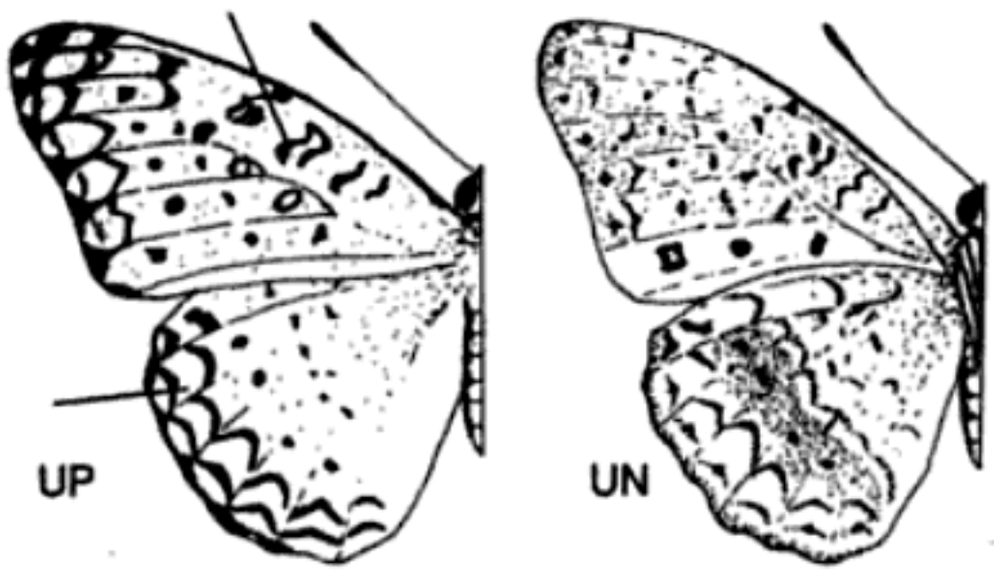
Length of caterpillar: 30 mm. Length of pupa: 17 mm.

32. Common Leopard

(Plate 16, no. 91)

Scientific Name *Phalanta phalantha* Drury
(Old: *Atella phalantha* Drury)

Field Characters Wingspan: 50–60 mm. This is a bright tawny butterfly marked with black spots. The underside is pale but glossy and fresh specimens have a bluish or purple sheen. The male and female look similar. The dry season form has a more prominent purple gloss on the underside.



Medium-sized, tawny with black spots

Similar Species The Small Leopard (*Phalanta alcippe* Cramer) is similar in appearance but considerably smaller (wingspan: 35–50 mm), is found in denser forests and usually lives in small groups. The Indian Fritillary (*Argyreus hyperbius* Linnaeus) (Plate 16, no. 94) male looks similar on the upperside, but is larger (wingspan: 65–85 mm) and its underside is rich green with silvery spots. The female (Plate 22, no. 127) mimics the Plain Tiger. This species, in southern India, is restricted to edges of shola forests and the montane grasslands of southern Western Ghats, but is also found in the Himalayas and northeastern India. Tamil Yeoman (*Cirrochroa thais* Fabricius) (Plate 16, no. 93), a Western Ghats endemic, is larger (wingspan: 60–70 mm). Its wings have a thin black border and no spots. It is common along forest streams in moist deciduous and evergreen forests. Two other species, quite dissimilar to the Common Leopard, but both tawny coloured, are locally common. These are the Cruiser (*Vindula erota* Fabricius) (Plate 16, no. 92) and the Baronet (*Euthalia nais* Forster) (Plate 16, no. 95). The former

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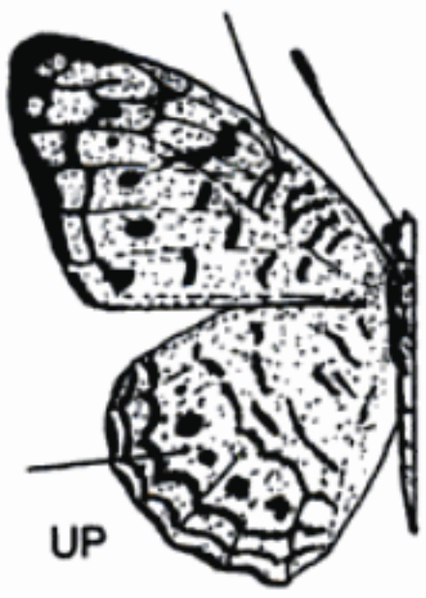
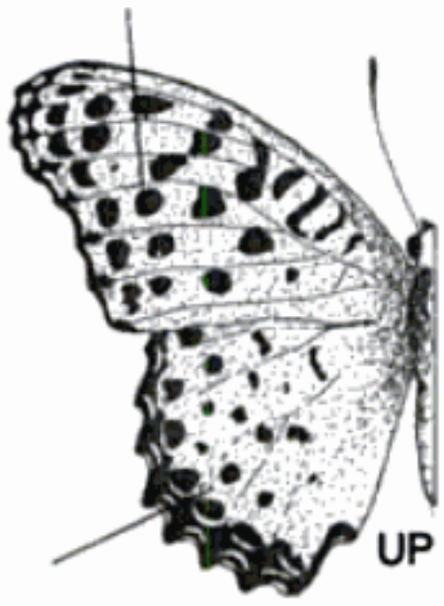
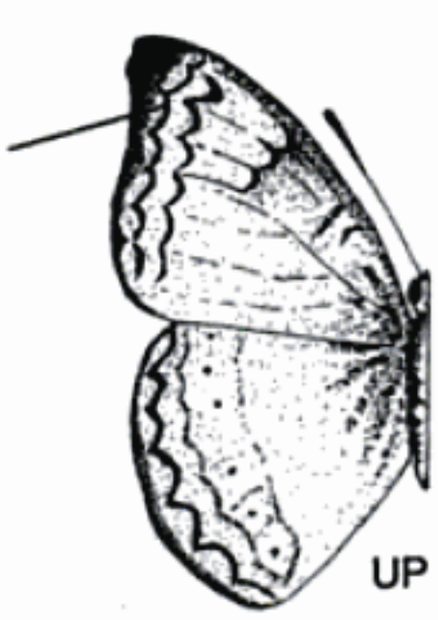
is very large (wingspan: 72–110 mm) and handsome. Its hind wing is toothed. It inhabits moist deciduous, semi-evergreen and evergreen forests. The latter is only slightly larger (wingspan: 60–70 mm), with a few black lines and spots on the wings and occurs in dry and moist deciduous forests. It is particularly common in the central Indian forests and the Eastern Ghats.



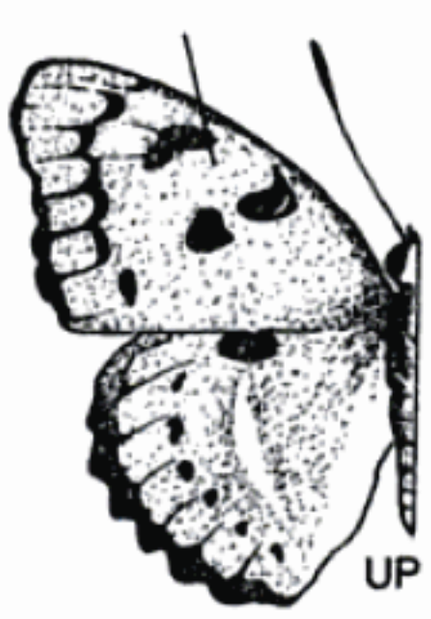
Small Leopard



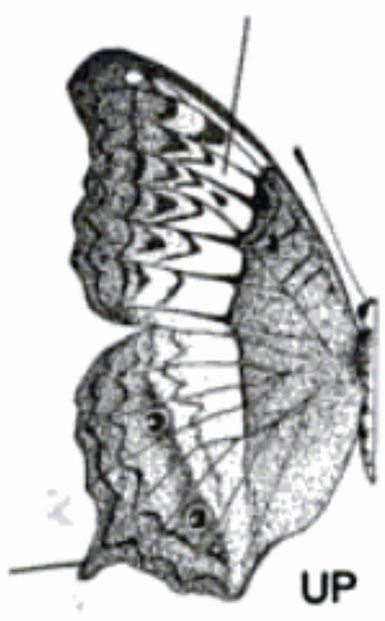
Indian Fritillary male



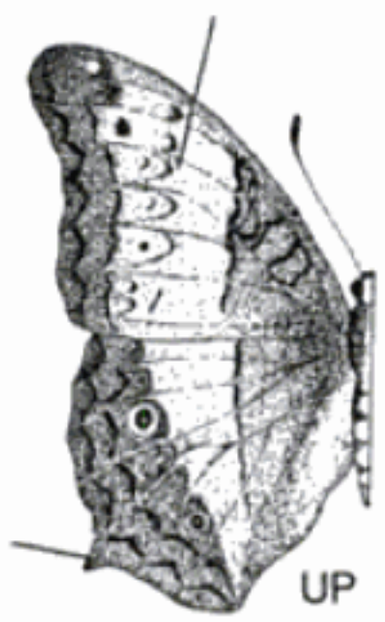
Tamil Yeoman



Baronet



Female



Male

Cruiser

Status, Distribution and Habitat This butterfly is most common in scrub and dry deciduous forests, but also inhabits moist deciduous forests, disturbed evergreen and semi-evergreen forest edges and openings. It is found throughout the year, but its abundance peaks during the pre-monsoon and early monsoon. This is a widely distributed species, from Africa to south and southeast Asia.

Habits The Common Leopard avoids shaded places and is most active in the hot noon sun. It flies with moderate speed but rapid wingbeats and settles often on branches of small trees and shrubs, usually avoiding flying high at the level of tall trees. It has a habit of flapping its wings very slowly for some time after it settles. It basks with its wings spread flat or half-open. A peculiar habit of this butterfly is guarding its territory. While basking, it chases off all other butterflies that come close to it. During the chase it is extremely quick on the wing. This behaviour is probably related to its 'perching' mate-locating strategy (see p. 24).

It feeds from flowers, where it settles with its wings half-open. It does not stay on a single flower for long and usually walks to the next one if the flowers are in inflorescence. It frequents the flowers of *Meyenia laxiflora, Gymnosporia montana, Lantana, Gmelina arborea, Mikania scandens* and *Alternanthera*. It also visits wet patches and sometimes dozens of individuals may assemble at mud-puddling sites.

Reproduction The Common Leopard breeds almost throughout the year, but its peak season is late summer when *Flacourtia* trees have new buds and fresh leaves. The tender leaves of these small trees are reddish. The butterfly lays its eggs on such leaves, usually on the underside. Many eggs may be laid on the same plant if there are enough leaves, but always one at a time. The egg is bright yellow and dome-shaped. It is ribbed vertically with cross-ridges in between. Some of the vertical ridges merge with each other.

The caterpillar rests stretched on the underside of the leaves. It is active and may be seen feeding at all times of the day. It quickly devours the soft, lush leaves and

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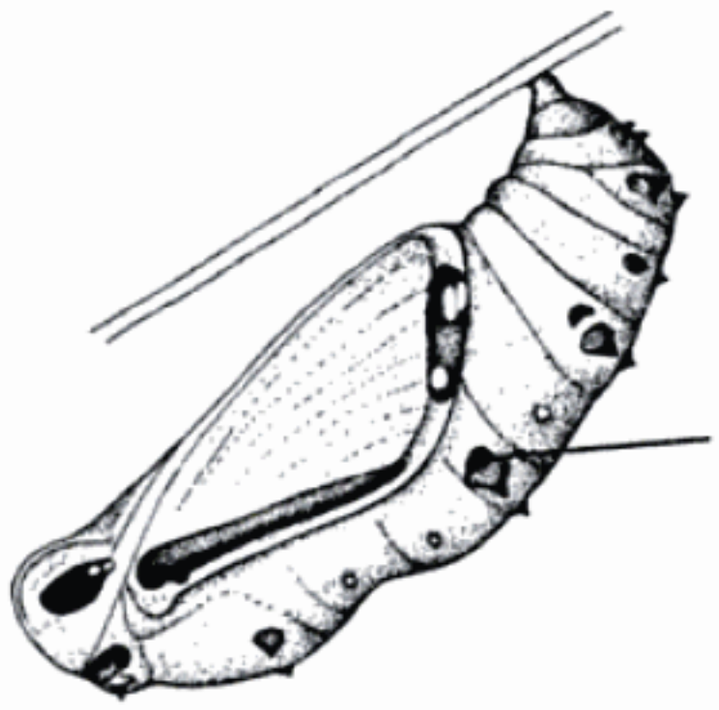
promptly moves on to the next twig or branch. It is thus common that the caterpillar is found on a different twig from the one that it has recently eaten. It drops by a silk thread from the plant if it is disturbed and hangs in mid-air, later climbing onto the leaf with help of the same thread. It is cylindrical and reddish-brown, with well-marked segments. The body surface is shiny and looks oily. The caterpillar is spiny, the spines in turn bearing small branches. The spines are black and they arise from distinct swollen tubercles. The head is smooth, shiny, a dirty yellow-brown and lacks horns. There is a sub-spiracular white, wavy line that runs from end to end of the body, except on the head.

Pupation takes place usually on the same plant or even the same branch on which the caterpillar last fed and the caterpillar turns green just before pupation. The pupa is very beautiful. It is bright green with shining red, black, golden and white markings. Small tubercles with conical projections arise from the abdominal segments. These tubercles are silvery-golden and the projections are crimson-red. However, if formed among dry branches, the pupa is creamy white with only black and golden-silvery markings.

This butterfly holds a record for rapid development. From the laying of the egg to the emergence of the adult from the pupa, the whole development may take only 21 days. The Rustic shares this record.



Length of caterpillar: 30 mm. Length of pupa: 17 mm.

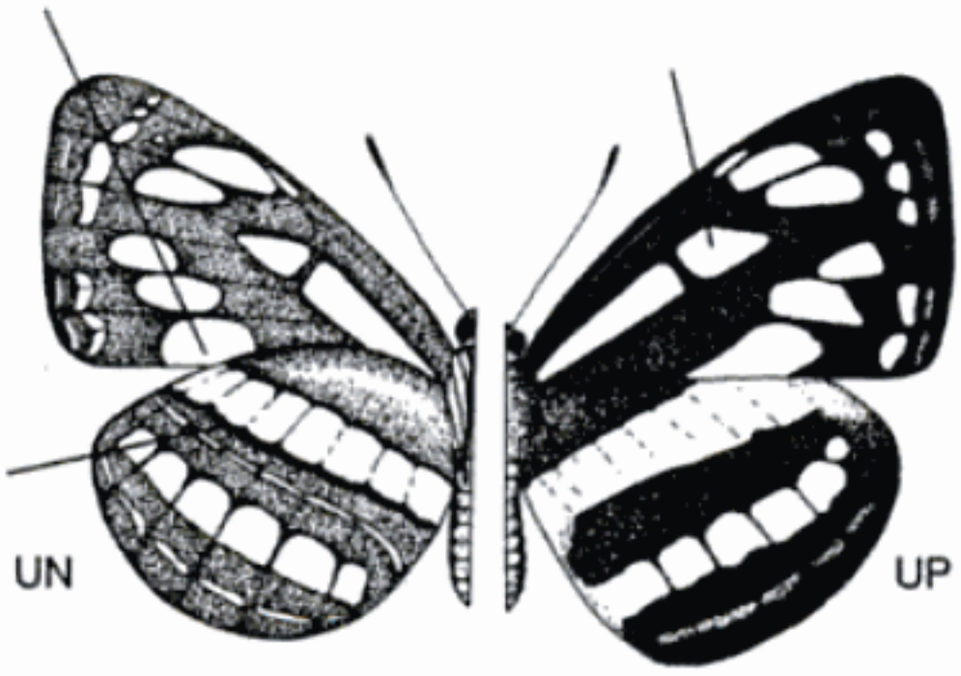
Larval Host Plants There are many host plants reported for this species and, surprisingly, from different families. These include *Flacourtia* spp. and *Xylosma longifolium* (Bixaceae), *Smilax* spp. (Smilacaceae) and *Salix* sp. (Salicaceae). Of these, *F. montana* and *F. indica* are the most widely used in the peninsular India.

33. Common Sailer

(Plate 16, no. 96)

Scientific Name *Neptis hylas* Moore

Field Characters Wingspan: 50–60 mm. The wings are black with two white bands composed of spots. The cell of the fore wing is almost entirely white, with a triangular white mark in front of it. The underside is chestnut and the central white band is outwardly edged in black. The wings are narrow. The body is metallic green with a brown sheen. The male and female have similar markings.



Medium-sized, black with white markings

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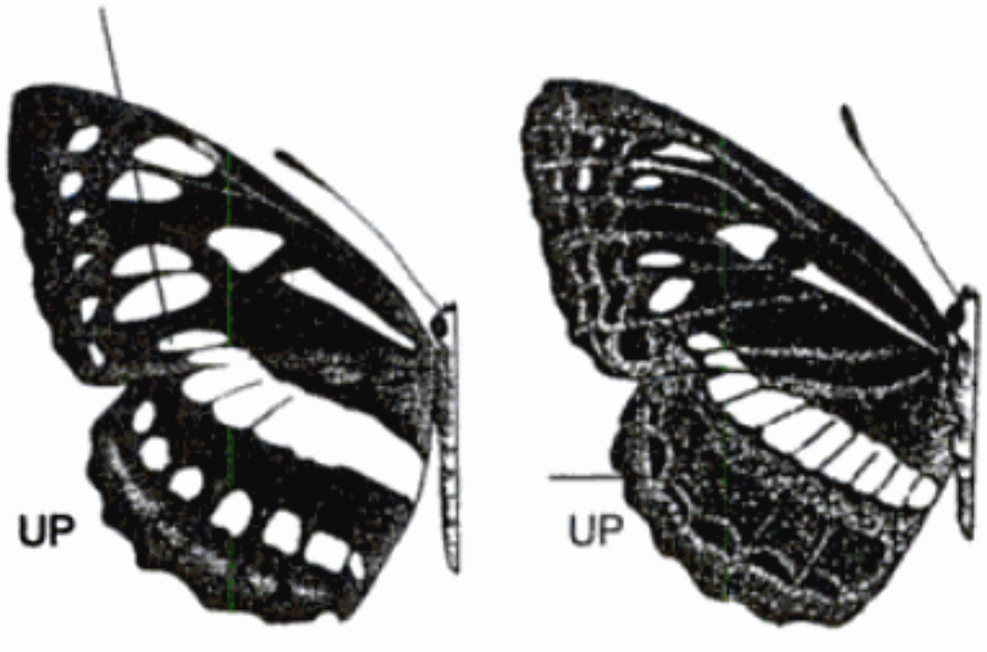
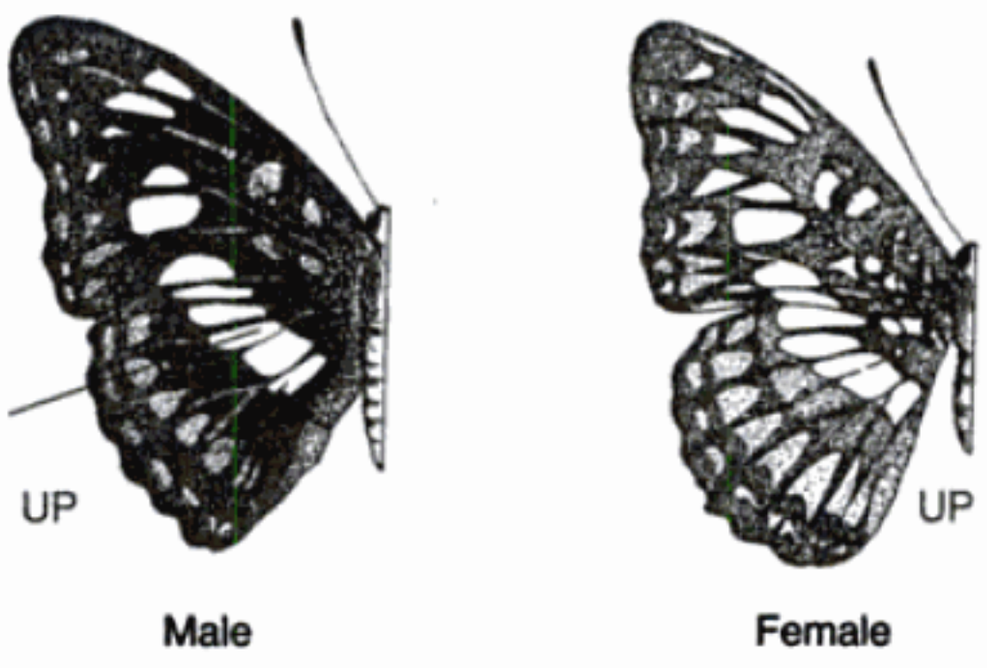
Similar Species There are altogether 6 species of similar-looking Sailers in peninsular India. Most of them are rare or uncommon and distinguishing between them in the field is usually difficult. Wynter-Blyth (1957) and Evans (1932) have given specific identification keys. However, two of the species should be mentioned because they are both locally common and easy to identify. These are the Short-banded Sailer (*N. columella* Moore; wingspan: 65–70 mm) and the Chestnut-streaked Sailer (*N. jumbah* Moore; wingspan: 60–70 mm). In both the species, if a line is drawn passing through the first two large white spots on the lower margin of the fore wing, the line meets the leading (front) margin of the wing. In the Common Sailer and other species from peninsular India, this imaginary line joins the outer margin of the fore wing. In the Short-banded Sailer, a series of large white spots is present near the outer margin of hind wing, but this line is absent or very thin in the Chestnut-streaked Sailer.



Short-banded Sailer *Chestnut-streaked Sailer*

The Common Lascar (*Pantoporia hordonia* Stoll) (Plate 17, no. 97), a smaller butterfly (wingspan: 45–50 mm), is found in the deciduous and evergreen forests of the Western Ghats. Its markings are similar to that of the Sailers', but they are yellow-orange, not white.

The other group of butterflies that looks very similar to the Sailers is the Sergeants. The Sergeants have broader wings and a more powerful flight. Among them, the Blackvein Sergeant (*Athyma ranga* Moore; wingspan: 60–70 mm) and Common Sergeant (*A. perius* Linnaeus; wingspan: 60–70 mm) (Plate 17, no. 98) are common. The former inhabits mainly evergreen forests, but also relatively less-disturbed moist deciduous and semi-evergreen forests, has a single broad white band on the wings and a spot in the cell of the fore wing. The Common Sergeant has markings similar to those of the Common Sailer, but has a short cell-streak followed by three white spots, instead of the Sailer's long streak and a single spot.



Male Female

Blackvein Sergeant

Common Sergeant

Status, Distribution and Habitat This is a common butterfly in wooded and hilly country. It prefers well-watered and densely vegetated nullahs in deciduous forests, but is seen in sunny patches. It also frequents paths, edges and openings in the evergreen forests and is as common there as in the deciduous forests. It ventures into scrub, human habitations and gardens as well. It is active all round the year, but relatively less common

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during summer. It is distributed all over the Indian subcontinent.

Habits The Common Sailer, as the name suggests, is a master of graceful sailing flight. It flies with the wings spread flat and glides without much effort. The necessary momentum and height are maintained by occasional flicks of the wings, during which it often changes direction. However, it is a quick flier and a superb dodger and therefore not so easy to net.

The Sailer sits on the substratum with its wings spread flat, be it the activity or resting period during the day. Occasionally it lifts its wings slightly, the movement suggesting a slow wing-flap, but never closes them. However, it closes them completely when it roosts, but does not draw the fore wings between the hind wings. Its black and white colour pattern seems very striking but it might actually make the butterfly inconspicuous. Along the forest streams or paths where the light conditions are always dappled, this colour pattern is actually obliterative.

This species feeds exclusively on flower nectar. Although the butterfly spends most of its time close to the ground, it also ascends up to the canopies of the tallest trees in the forest. Thus it feeds from flowers of herbs to giant trees, moving comfortably in all the vegetation layers. In hot weather it is greatly attracted towards wet patches and a number of individuals might congregate at the same patch.

Reproduction The egg is laid at the tip of a leaf and always on its upper surface. The caterpillar creates an unusual setting around itself to hide. It partly eats the leaf, tears the remainder to pieces and joins together the shreds by the silk that it produces. Thus, some leaf portions dry and wither, others remain green but in pieces. On the leaf, the caterpillar rests in the open with its head turned to one side and bowed. The droppings of the caterpillar lie abundantly on the leaf itself. This is an interesting setting when one considers the caterpillar and processes on its body. The caterpillar is dirty-brown but without any definite colouring as the individual caterpillar and each instar adjusts to the colour of the surrounding leaf pieces. The surface of the body is set with numerous processes. These processes are borne on thick tubercles. The spiny processes themselves bear short hair. These are flat at the top and curved outward and downward. A thin dorsal line is also present. The colouration and outgrowths on the body disrupt the outline of the caterpillar and thus it is very difficult to locate it even though it rests in the open. It makes short trips for feeding to neighbouring leaves or to untouched parts of the same leaf on which it rests.

The pupa has a short head and thorax and a bulging abdomen. The head is set with short points. The thorax is somewhat humped. The pupa is broadest at the 6th segment. The surface is rough with a few conical tubercles on abdominal segments. It is yellowish-green with numerous brown blotches and lines all over the body.

Length of caterpillar: 21 mm. Length of pupa: 9 mm.

Larval Host Plants The host plants are diverse, from many families and of different growth-forms; from herbs to large trees. They include *Bombax ceiba, Canavalia gladiata, Corchorus* sp., *Flemingia* sp., *Grewia* sp., *Helicteres isora, Lathyrus* sp., *Mucuna purpurea, Nothapodytes nimmoniana, Paracalyx scariosa, Triumfetta* sp., *Vigna cylindrica, Vigna unguiculata* and *Xylia xylocarpa* (Bombacaceae, Fabaceae, Icacinaceae, Mimosaceae, Sterculiaceae and Tiliaceae).

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34. Commander

(Plate 17, no. 99)

Scientific Name *Moduza procris* Cramer
(Old: *Limenitis procris* Cramer)

Field Characters Wingspan: 60–75 mm. This is one of the vividly coloured forest butterflies. The upperside is a brilliant reddish-brown. The mid-region of its wings has a series of broad snow-white spots forming a band, in addition to other scattered spots. The hind wing margin is wavy. The underside is predominantly greyish-white. The male and female are similar in appearance.

Medium-sized, reddish-brown with a white band

Status, Distribution and Habitat The Commander is found in the forests of Sri Lanka, southern and peninsular India, extending from Dehra Dun eastwards along the Himalayan foothills and northeast India to southeast Asia. It is locally a very common butterfly and is most abundant along water-courses in the dry and moist deciduous forests. It is also found along forest roads, edges and other openings in the semi-evergreen and evergreen forests. It may also be found close to villages and other human settlements, where its host plant, *Mussaenda*, is planted in gardens. It is most common during post-monsoon and winter.

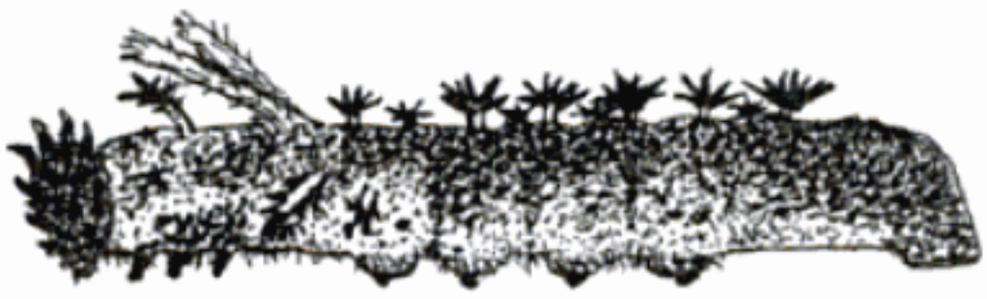
Habits This butterfly is often seen among the pale pebbles or sand in the stream-beds where it settles with wings pressed flat. This posture is usually maintained whether it is basking or feeding. It is difficult to overlook this butterfly owing to its striking colours and boldness. Nevertheless, it is seldom possible to approach it as it is wary and keeps its distance by taking short flights. Once it has settled and is engrossed in feeding, it is easier to approach. However, on being disturbed continuously, it takes refuge in the nearby bushes where it might sit with its wings closed over the back. Apart from drinking from wet patches, it is fond of nectar and therefore visits the flowers of herbs, shrubs and small trees, rarely ascending to large trees.

Its flight is swift with a few rapid wingbeats and intermediate spells of gliding that are quite graceful. Although a powerful flier, it flies usually in short bouts and does not travel far.

During the hot hours of the day, the males select an exposed branch of a tree or high bush and drive away other butterflies that come close to them.

Reproduction The behaviour of the caterpillar is very similar to that of the Common Sailer. It partly eats the leaf, tears the rest to pieces and joins them together in shreds in much the same way. For a detailed description the reader may refer to the section on the Common Sailer. Since the caterpillar adopts a similar strategy to remain unnoticed, the processes on the body of the caterpillar are also similar. It is dirty grey with a chestnut-brown tinge and dark brown blotches all over the body.

Before pupation the caterpillar wanders some distance from the host plant. Pupation takes place among dried leaves, twigs, etc. The pupa is angular with prominent wing expansions and flat processes on the head. It



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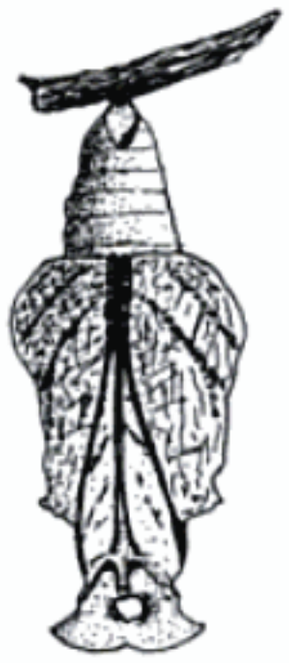


Length of caterpillar: 32 mm. Length of pupa: 24 mm.

looks very similar to a dry rolled leaf and is therefore difficult to locate.

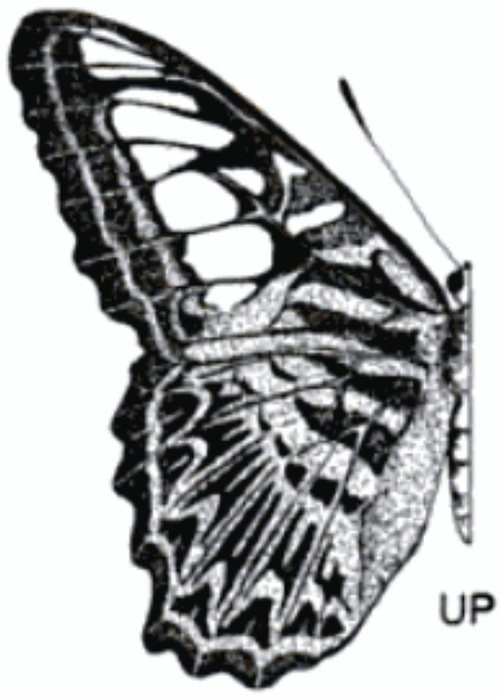
Larval Host Plants The larval host plants are large trees or shrubs and include famous trees such as Kadamba (*Neolamarckia cadamba*) and cinchona. Other host plants include *Cadaba fruticosa, Hedyotis orixense, Mitragyna parvifolia, Mussaenda frondosa, Ochreinauclea missionis, Wendlandia exserta* and *Wendlandia thyrsoidea* (Capparaceae and Rubiaceae).

35. Clipper

(Plate 17, no. 100)

Scientific Name *Parthenos sylvia* Cramer

Field Characters Wingspan: 105–125 mm. The Clipper is a very large, beautiful bronze-green butterfly. It has a series of large, semi-transparent, snow-white spots on its fore wings. The hind wings are marked with black spots. Numerous black spots and streaks are also present on the fore wings as well as the hind wings. The male and female look similar.



Large, bronze-green with white and black markings

Status, Distribution and Habitat This is strictly a forest-dweller and occurs in wet evergreen, semi-evergreen and relatively undisturbed riverine moist deciduous forests. It is particularly concentrated along water-courses and in the canopy openings. However, occasionally it ventures out in forest plantations, areca nut and rubber cultivations if these are surrounded by good forests. It is active throughout the year, but September to February is the peak season. It is common in its preferred habitats, and is uncommon in other habitats where it is sometimes found. It is distributed in the Western Ghats, parts of the Eastern Ghats, in the Himalayan foothills from Dehra Dun eastwards to the entire southeast Asia.

Habits This beautiful butterfly has a graceful, swift and powerful flight. It takes off with a jerk, darts straight forward, beats a few wing-strokes and then glides swiftly. While gliding, its wings are pressed below the body plane in the manner of the Barons. It flies with equal ease in the forest canopies as well as near the ground and uses all vegetation layers equally frequently.

It settles on peripheral branches high up in the trees or in very tall bushes, as if looking down at the world below. From this perch it makes occasional sallies into the air to chase away other butterflies or glides down to the undergrowth to feed on nectar. While perching on a tree, basking or feeding from a flower,

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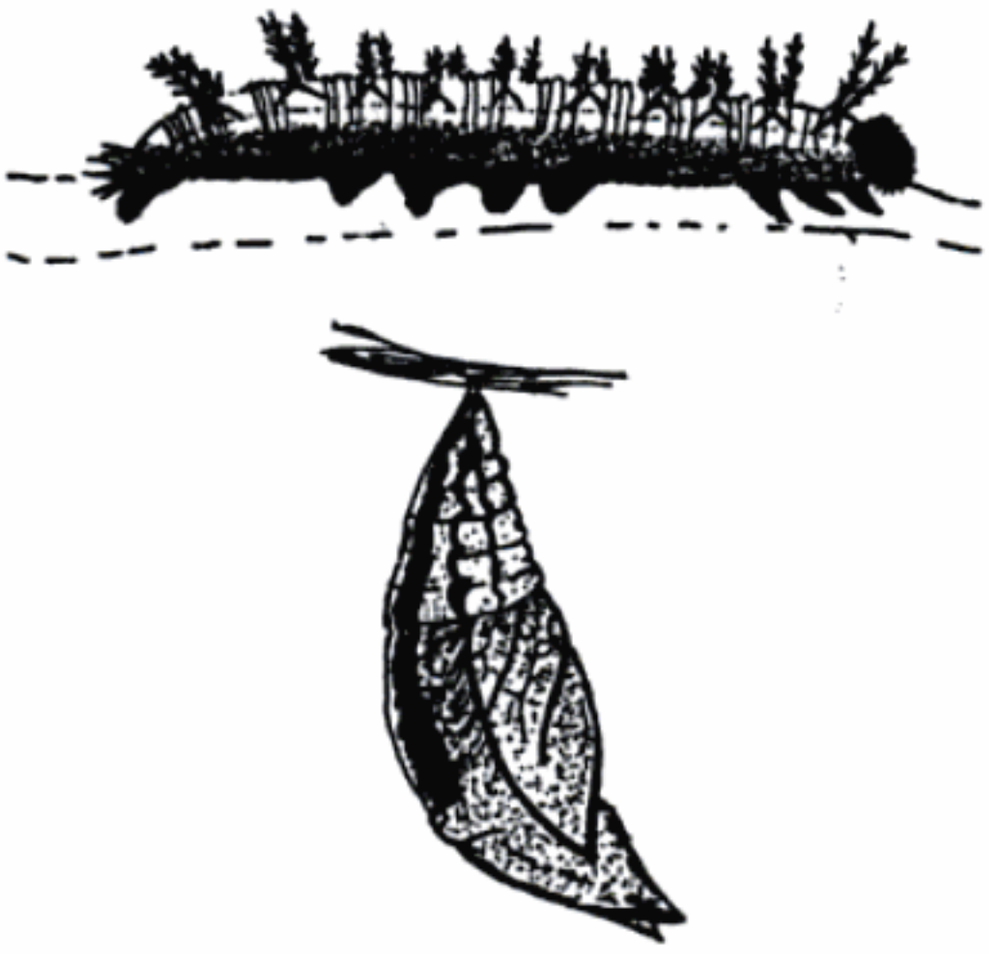
its wings are always stretched wide. It also visits moist soil patches.

In the late evenings it clings to the underside of leaves on terminal branches of trees, usually at a height greater than 4 m and hangs upside down to sleep, the wings still spread flat.



Reproduction The caterpillar is pale green with a yellowish-white lateral stripe. The head and anal segments bear short spines. Segments 3–12 bear long reddish-brown spines that, in turn, are branched. The pupa is stout and angular.

Larval Host Plants The caterpillars feed on *Adenia hondala* (Passifloraceae) and *Tinospora cordifolia* (Menispermaceae).

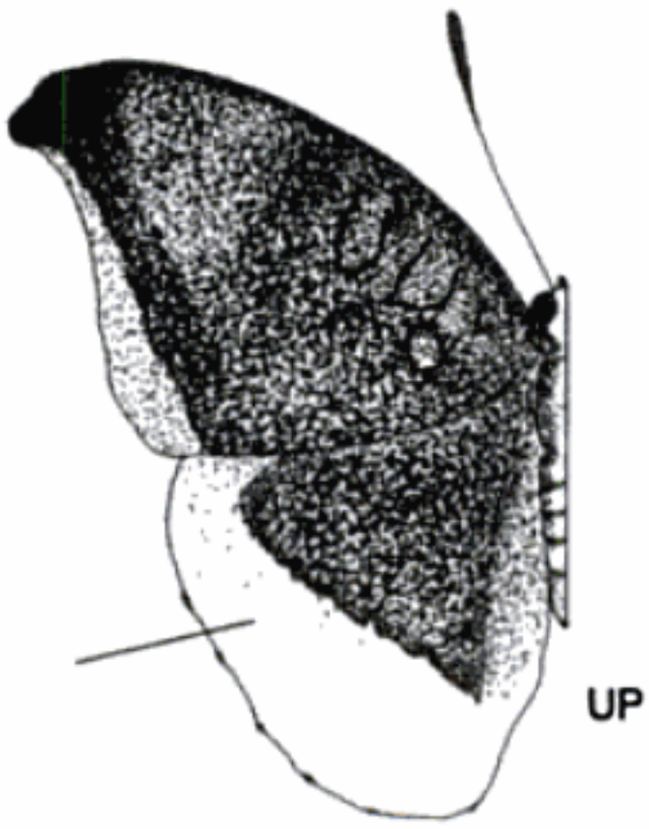
Economic Significance This is a huge and very pretty butterfly. In his book, Wynter-Blyth (1957) rated this butterfly sixth in rank among the most beautiful Indian butterflies, next to the Birdwings. Butterfly collectors covet this species and fresh undamaged specimens fetch a high price. Specimens from southern India are especially highly prized.

36. Grey Count

(Plate 17, no. 101)

Scientific Name *Tanaecia lepidea* Butler
(Old: *Euthalia lepidea* Butler)

Field Characters Wingspan: 65–80 mm. The Grey Count is a dark brown butterfly with a slight bronze-coloured sheen. There are short black lines on the fore wings but the most striking charactereristic is the pale grey or silvery white margin of the hind wings, which also extends to the lower half of the fore wings. The underside is pale grey with numerous black markings The sexes look alike.



Medium-sized, dark brown with white

Similar Species The male Common Baron is similar in markings, minus the silvery-grey border to the wings.

Status, Distribution and Habitat This is a butterfly of low and mid-elevation deciduous forests. It is particularly common in riverine patches in the moist deciduous forests and in forest clearings or paths in evergreen forests. It prefers shaded places. It is active throughout the year, but usually uncommon during the monsoon months. It is distributed over the Western Ghats, parts of the Eastern Ghats, then from Kumaon eastwards to southeast Asia.

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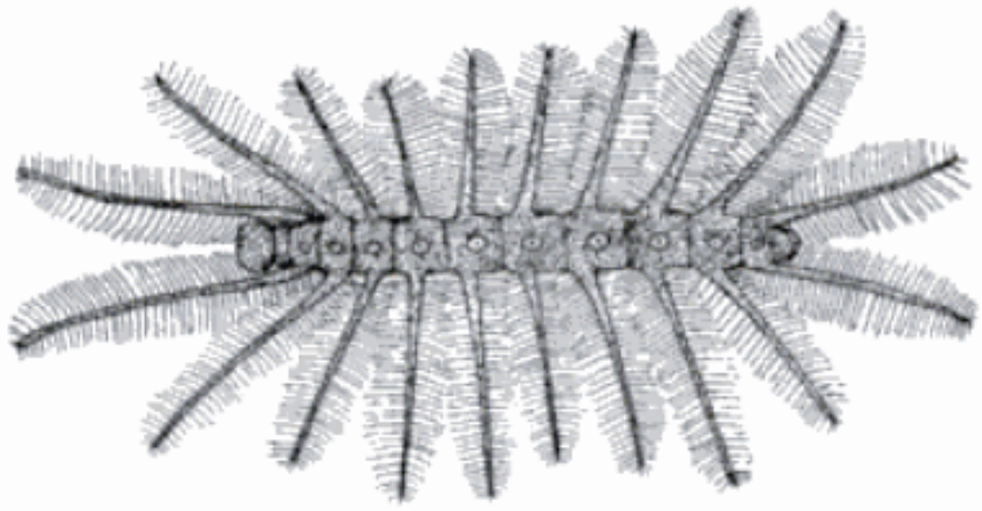
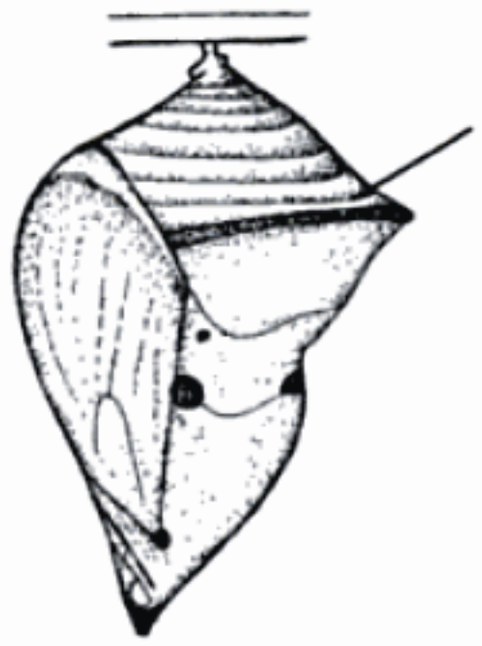
Habits While walking along a stream in the forest, the Grey Count attracts one's attention due to the moon-shaped crescent on its wing margins. This looks particularly remarkable in the case of fresh specimens, in which the crescent is silvery-grey and shiny. It sits on moss-laden rocks and fallen logs in the stream-bed with its wings spread flat. When it basks, it keeps its wings spread and facing the rays of the sun. Like the other 'Barons' it has a habit of moving its wings slowly up and down once in a while, especially when it moves a few steps while feeding. It is a strong flier. However, it rarely flies far or high. When disturbed, it smoothly and gracefully slips through the vegetation and rocks and settles soon. Its flight seems effortless and it mostly glides, sustained by occasional wingbeats.

It feeds from wet soil, on tree-sap and rotting fruits, occasionally bird-droppings and may go high up in the trees in search of tree-sap.

Reproduction Its reproductive behaviour is very similar to that of the Common Baron. The caterpillar has similar branched spines on the body and behaves in a similar manner. The difference lies in the markings on the back. The Grey Count has hexagonal white marks that are suffused with brown and with a central blue spot. The pupa differs slightly in shape, but is otherwise similar. It is marked with more golden spots. A pupa found in the northern Western Ghats yielded over 150 tiny Chalcid wasps.





Length of caterpillar: 40 mm. Length of pupa: 18 mm.

Larval Host Plants The larval host plants of the Grey Count are two large trees that are common in the deciduous forests. They are: *Careya arborea* and *Melastoma malabathricum*.

37. Common Baron

(Plate 17, no. 102 and Plate 18, no. 103)

Scientific Name *Euthalia aconthea* Cramer
(Old: *Euthalia garuda* Moore)

Field Characters Wingspan: 55–80 mm. The male Common Baron is dark brown with a row of very small white spots on the fore wing. The female is pale brown with a prominent white band on the fore wings. Both the males and females have black dots on their hind wings. The wings have a deep olive-green sheen and therefore appear olive-green rather than brown. The underside is white with sparse black markings. The thorax is much more robust compared to the abdomen. The proboscis is green, but in newly-emerged individuals it is yellowish. The female is much larger than the male.

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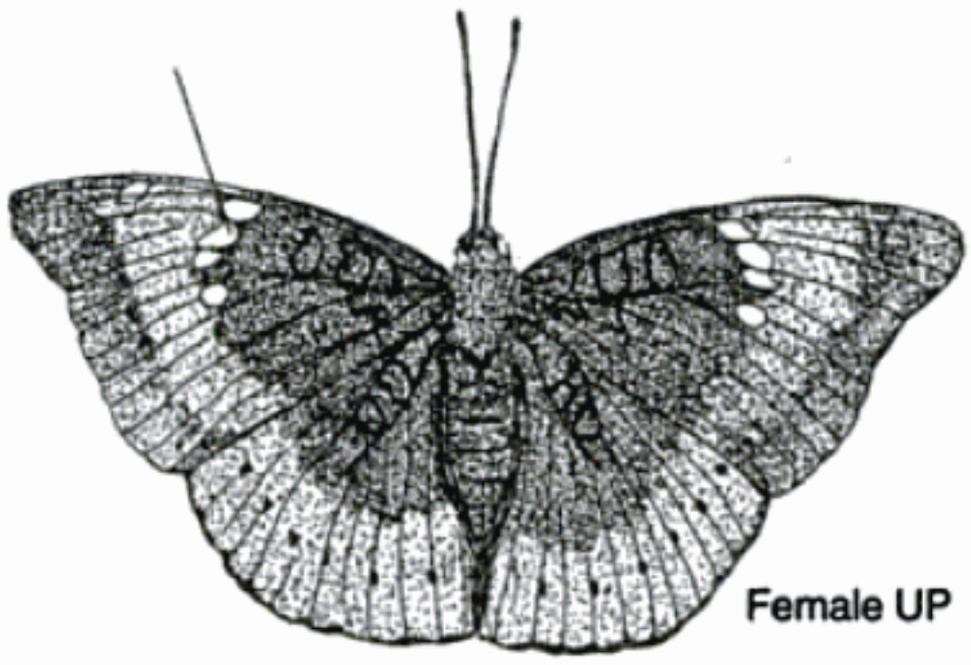
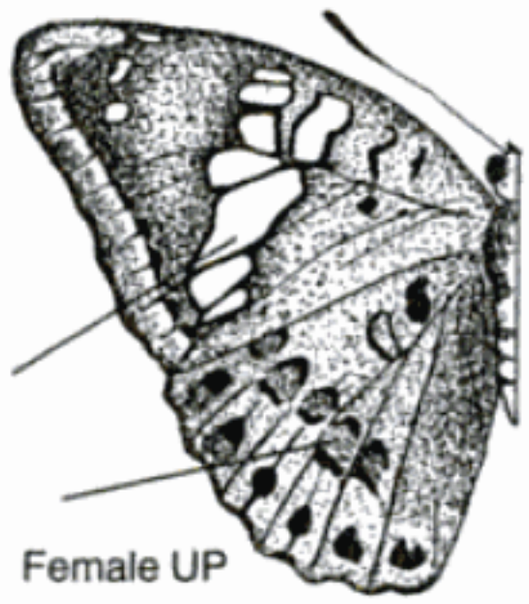
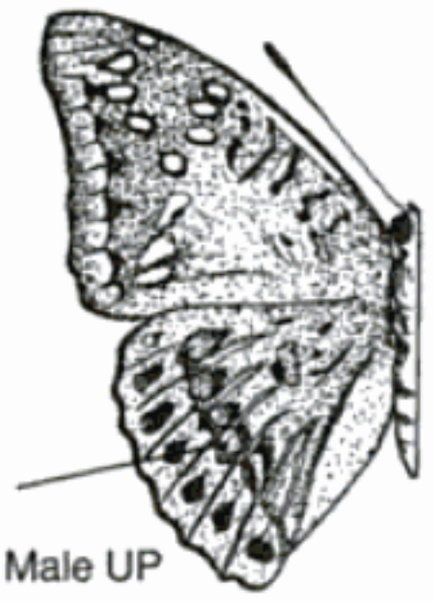


Female UP

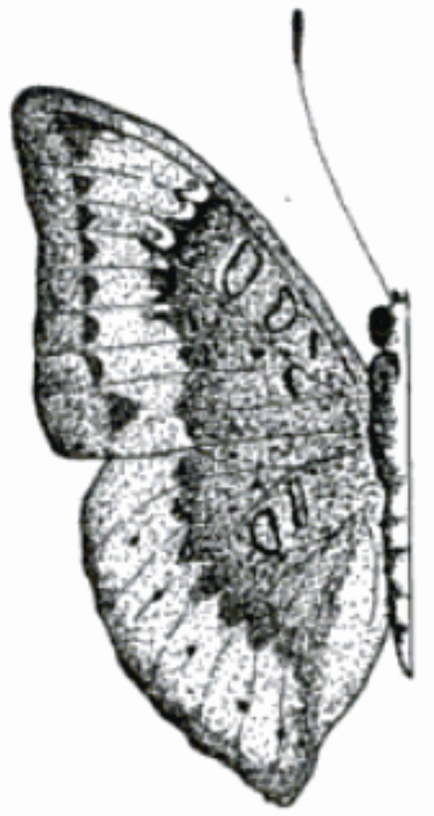


Female UP

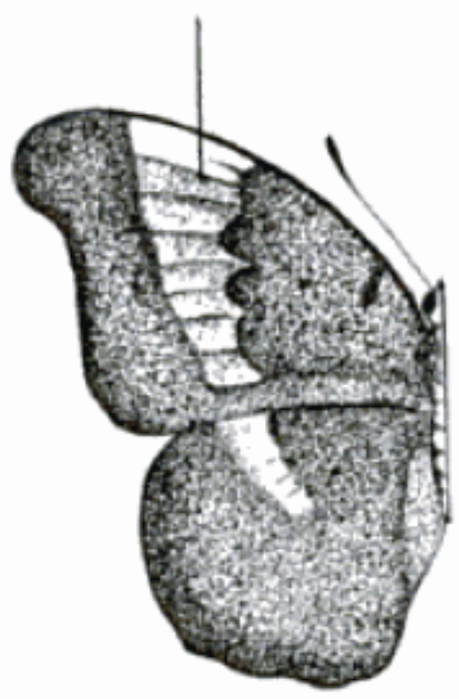


Male UP

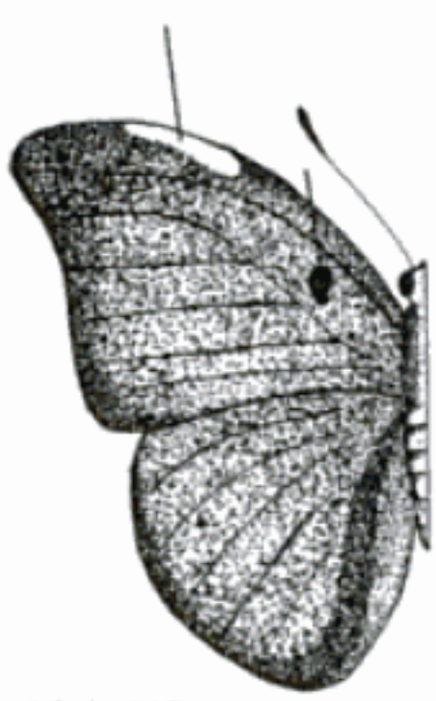
Gaudy Baron



Male UP



Female UP



Male UP

Red-spot Duke

Medium-sized, olive-green with black and white markings

Similar Species A layperson may confuse the Chocolate Pansy with the Common Baron. However, they have different markings (compare the illustrations) and entirely different habits. The Chocolate Pansy is darker and has a less impressive colouration and sitting posture. Also, the apex of its fore wing is produced.

The Grey Count is similar in colouration and habits, as it is related to the Common Baron. However, it has a broad gray margin on the hind wings. The Gaudy Baron (*E. lubentina* Cramer) is brightly marked with crimson spots and inhabits deciduous and semi-evergreen forests. The Red-spot Duke (*Dolpha evelina* Stoll) (Plate 18, no. 104) distantly resembles the female Common Baron. It is much larger (wingspan: 93–110 mm), is bronze-green with a very broad, outwardly diffusing white band on its fore wings (only in the female) and a red spot at the base of its fore wings. It usually inhabits evergreen forests.

Status, Distribution and Habitat The Common Baron is seen in almost all habitats except dry scrub and grasslands. In the deciduous forests it usually occurs in riparian patches, while in the evergreen forests it may also be seen in large openings. It is uncommon in the forests, but common around human habitations as its caterpillars feed on the leaves of mango trees. It is more active during the winter and early summer, becoming rare before and after this period. The distribution ranges over all of south and southeast Asia, from Sri Lanka to the Sunda Islands.

Habits The Common Baron and its allied species (genera *Euthalia, Dolpha,* and *Tanaecia*, the "Barons") are characterized by a very strong and broad thorax that hints at their powerful flight. This, coupled with the pointed fore wings and rounded hind wings, gives them a majestic appearance.

This butterfly always rests with its wings spread flat and in a slanting position; the margins of the hind wings touching the ground

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and the fore legs raised, lifting the body. It is wary and swiftly dashes forward on human approach, but never flies far and settles soon. It prefers to rest on the ground or on boulders but also settles on trees. Occasionally it may bask high up in the trees with its wings spread flat and settles even on the underside of leaves. When in the air, its flight is sustained by a few powerful and rapid wing-strokes and then it glides swiftly and gracefully. While gliding, its wings are pressed lower than the horizontal plane of the body. The butterfly often returns to the same spot. It is not a wanderer and spends most of its time sitting on the ground, feeding, etc.; restricting its activities to a small area, usually in the vicinity of the larval host plants.

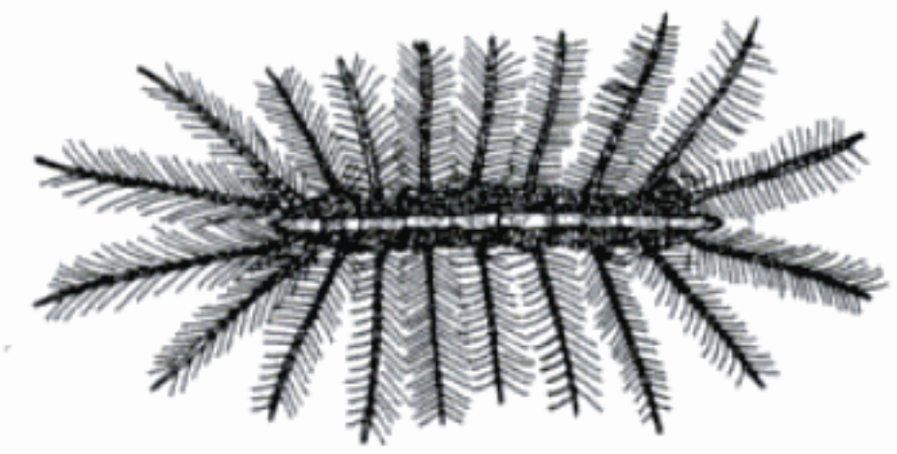
It is a habitual alcoholic. It is not attracted to any flowers at all. Instead, it greatly relishes fallen, rotting fruits that are rich in alcohol. This is one of the butterflies to be expected on a pile of fallen fruits under a fruiting tree. It frequently visits wet soil patches also and, very occasionally, bird-droppings.

Reproduction The female lays eggs singly on the upper surface of leaves, usually not less than 5–6 m off the ground. The egg is dome-shaped and plain green. It has sparse, fine, hairy outgrowths all over the surface except the top, which has a small pit.

The caterpillar stays on the mid-rib on the upper surface of a leaf. It is a plain leaf-green except for a line on the back, which is alternately blue and yellow. It is spiny, each segment bearing two long spines near the dorsal surface, one on each side, which are pressed flat to the leaf surface. These spines are profusely branched and thus they completely cover the caterpillar except for the thin line on the back, which is exposed. The blue-yellow line on the back corresponds to the mid-rib of the leaf and the spines, the veins and smaller veins. Thus, even if the caterpillar is exposed on the upperside of the leaf, it is very difficult to find it if one is not specifically looking for it. It eats the leaves along the edges, but does not eat them to a significant degree, which otherwise may ruin its camouflage.

When the caterpillar is full-grown, it wanders from the branch to find a place to pupate. It often drops down from the tree by means of a silk thread and then walks away on the ground to a secluded place. The pupa is very characteristic. Its head is set with two points in the front, which are red with black bases. The thorax and head are small, the abdomen very large, pointed at the back and expanded on the sides. It is grass-green and the surface is extremely smooth and shiny. It is marked with glistening golden lines and streaks and a large black-ringed red spot at the back of the thorax.

It is parasitized by Chalcid wasps. Up to two hundred wasps may emerge from a pupa.



Length of caterpillar: 34 mm. Length of pupa: 22 mm.

Larval Host Plants The most common and preferred larval host plant is the mango (*Mangifera indica*). In coastal Maharashtra and perhaps in other states too, it feeds on the cashewnut plant (*Anacardium occidentale*; both Anacardiaceae). *Bryonia* sp., *Morus* sp., *Rosa* sp., *Scurrula parasitica* and *Streblus asper* (Cucurbitaceae, Loranthaceae, Moraceae and Rosaceae) are also recorded, but probably rarely used.

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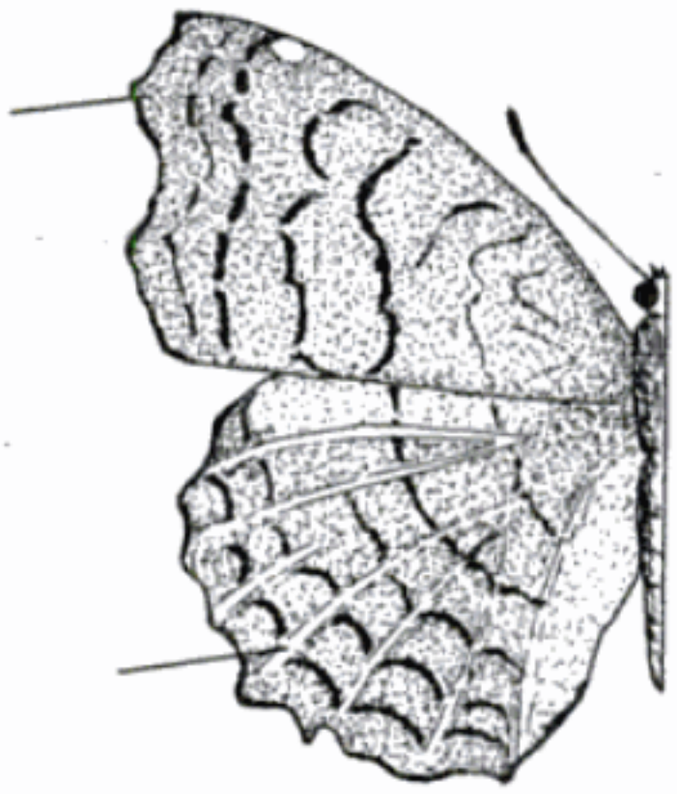
38. Angled Castor

(Plate 18, no. 105)

Scientific Name *Ariadne ariadne* Linnaeus
(Old: *Ergolis ariadne* Linnaeus)

Field Characters Wingspan: 45–60 mm. The Angled Castor is a dark ochre butterfly with sparse, wavy, dark brown lines on its wings. Towards the apex of the fore wing is a conspicuous white spot. The margins of its wings are wavy and its fore wing is angled at the apex. The underside is similar but darker. The female is slightly paler.



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Medium-sized, rusty with black markings

Similar Species The wing margin of the Common Castor is not so wavy and the black lines on the wings are denser.

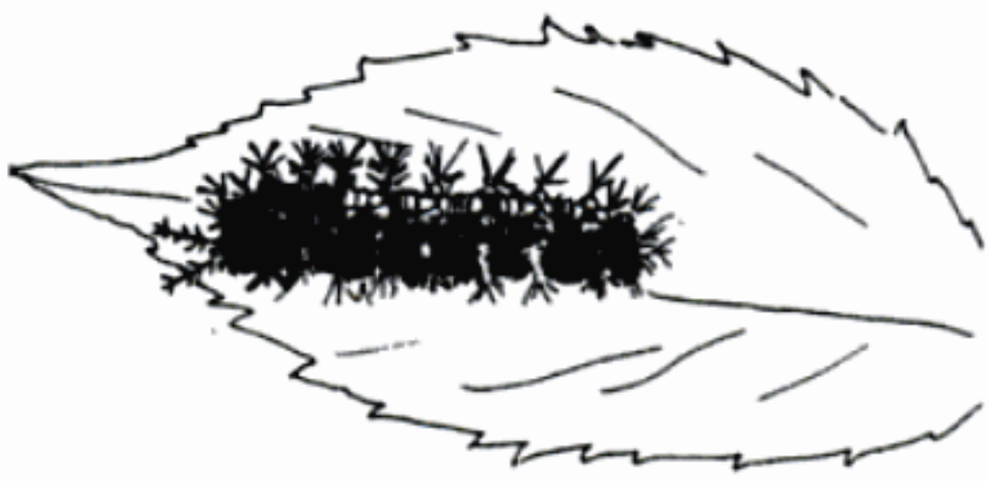
Status, Distribution and Habitat This butterfly inhabits scrub and secondary deciduous forests, especially rocky outcrops, where the microclimate is dry and the vegetation is disturbed. It also occurs in the highly disturbed patches in evergreen forests and around human habitations. It is common in all these habitats and active throughout the year. It is widely distributed in the entire Indian subcontinent, except in the dry north-west zone.

Habits The Angled Castor is a weak flier and flies close to the ground. It flies jerkily with intermittent spells of sailing and halts every now and then to rest. It perches on suitable branches not much above the ground, with its wings spread flat, occasionally moving them slowly.

It is a pugnacious butterfly, which clumsily chases away other butterflies that happen to come close.

Reproduction The caterpillar is dark brown with a broad white dorsal stripe. There are four branched spines on each segment, together forming rows on the body, which probably prevent oviposition by parasitoids. It eats leaves voraciously, moving to adjacent leaves after finishing one.

The pupa is slender and may be fixed perpendicularly to the support.



Length of caterpillar: 22 mm. Length of pupa: 18 mm.

Larval Host Plants The host, as the name indicates, is the castor plant, *Ricinus communis*, of family Euphorbiaceae. In hilly areas or dry scrub, the caterpillars feed on *Tragia*

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involucrata and *T. plukenetii*, from the same family.

Suggestions for Student Projects Observe the larval host plant preferences of the Angled Castor and the closely related Common Castor, in places where their ranges overlap. Do they use same the food sources? Is their behaviour different from each other?

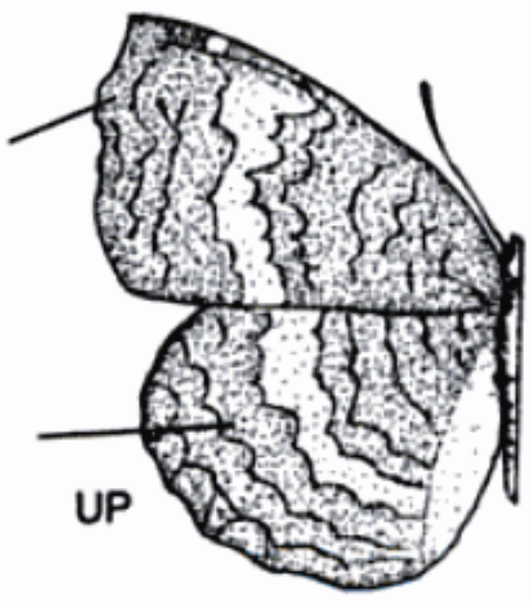
Contributed by *E. Kunhikrishnan*

39. Common Castor

(Plate 18, no. 106)

Scientific Name *Ariadne merione* Cramer
(Old: *Ergolis merione* Cramer)

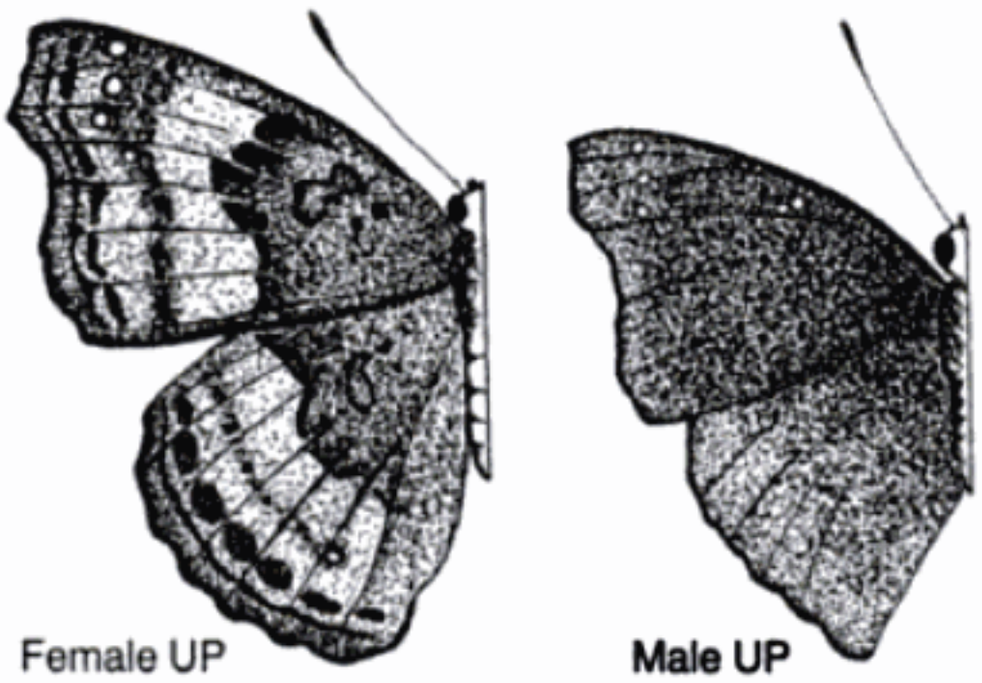
Field Characters Wingspan: 45–60 mm. The Common Castor is a rusty-brown butterfly with wavy black lines on its wings. A white dot is present on the front margin of the fore wings. The margins of the hind wings may or may not be wavy. The underside of the wings is much darker, but of the same colour.



Medium-sized, rusty with black markings

Similar Species The Angled Castor is similar in overall appearance. It is darker, the margins of the hind wings are more wavy and the black lines on its wings are also more wavy and placed farther apart. It is usually rare as compared to the Common Castor, but at a few localities, it may be more common.

The female Black Prince (*Apatura parisatis* Westwood) looks similar, but it has a pale central narrow band on its wings and lacks black wavy lines on the wings. The male is velvety black and its fore wings are narrow and pointed.



Black Prince

Status, Distribution and Habitat The castor plants, on which this butterfly's caterpillars feed, are spread throughout India, and with them, the butterfly also. It is very common in the proximity of this plant. It is also seen in drier, grassy areas where its other larval host plants, the stinging nettles, (*Tragia* spp.) occur. However, it is less common in such areas. It occurs throughout the year with hardly any seasonal fluctuations in numbers. The distribution ranges over the entire Oriental region.

Habits The castor plant is characteristic of Indian rural environment as much as it is of neglected corners in modern suburbs. It grows luxuriantly along open water run-offs and sewage drainages. The Common Castor has a strong association with this plant. Around human habitation its caterpillars feed exclusively on castor leaves. Therefore, the butterflies crowd in the vicinity of this plant either to lay eggs or find mates. On the plants,

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the butterfly sits always with its wings wide open, occasionally moving them slowly.

The butterfly is lazy. Its flights are short and it often comes back to the same spot. It mainly glides, the gliding sustained by periodic wingbeats, but the whole motion is ungainly.

It is rarely seen indulged in feeding. It has been reported to feed from flowers and on plant-sap.

Reproduction The female settles on the underside of a leaf, usually away from the margins and lays eggs singly. However, occasionally three or four eggs may be found together. The egg is white, hairy and ornamented with fine reticulation that is generally concealed under the hair.

The caterpillar remains on the underside of the leaf for a few hours or even until it is a day old. Then it walks onto the upper surface of the leaf and stays there throughout its larval life. It eats the edges of the leaves and rests stretched quite openly on the leaf keeping its head bowed. However, due to its colouration it does not look conspicuous on the leaf. It is green with a longitudinal dorsal brown band, a yellow sub-dorsal line and two more yellow lines on the sides. It is horned and spined. The horns and the spines are green and branched, but the horns may sometimes be brownish. The caterpillar is slow and does not move much during the day, feeding mostly at dusk and night. If disturbed it moves its head and thoracic segments sideways, but never falls to the ground or walks away.

Length of caterpillar: 27 mm. Length of pupa: 18 mm.

Pupation often takes place on the host plant itself. The pupa is elongated. The wing-cases are slightly expanded and the thorax has a triangular projection. The head bears two short processes. It is green or brown in colour and marked with a variety of darker streaks and lines. The surface of the pupa is slightly shiny and smooth. The pupa shakes sideways when disturbed and remains bent on one side for some time even after the disturbance is past.

Larval Host Plants The host plants are the castor plant (*Ricinus communis*) and the stinging nettles (*Tragia involucrata* and *T. plukenetii*; Euphorbiaceae). Their utility is probably dependent on the availability of the plants and therefore the castor plants are more frequently used.

Suggestions for Student Projects This species is suspected to be unpalatable and hence protected. Two rare species, the Tabby (*Pseudergolis wedah* Kollar) and the female of the Black Prince, have similar markings to the Common Castor. According to Wynter-Blyth (1957), this may not be a case of mimicry. It is probably a convergent colour pattern, which is most suitable for other reasons such as its inconspicuousness. But this species flies slowly. The question whether this butterfly is unpalatable or not, therefore, remains unsolved. The bee-eaters have been observed to hunt the Common Emigrants that fly much faster and are therefore difficult to catch. However, they ignore the slow-flying Common Castors.

Simple experiments can be carried out in captivity using lizards as predators. Their

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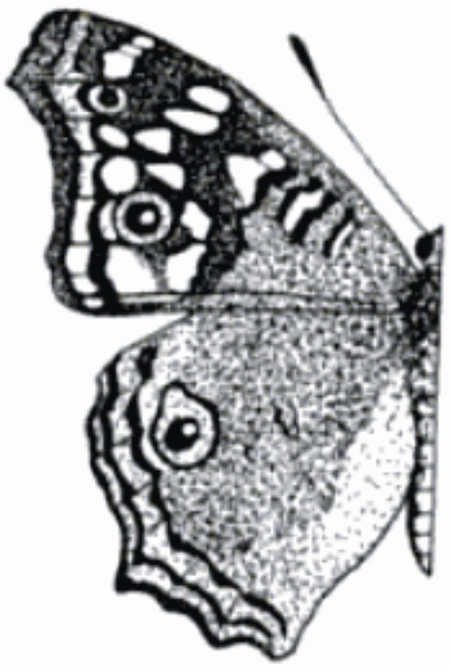
food preference can be studied for the species in question, in contrast to other butterfly species. After initial experiments, chemical assays, if needed, may be done to confirm the presence of unpalatable compounds in this species.

40. Lemon Pansy

(Plate 18, no. 107)

Scientific Name *Junonia lemonias* Linnaeus (Old: *Precis lemonias* Linnaeus)

Field Characters Wingspan: 45–60 mm. A brown butterfly with numerous eye-spots as well as black and lemon-yellow spots and lines on the fore wings and hind wings. In the dry season the markings are reduced and in the wet season they are more prominent and larger. The colouration on the underside of the wings is also variable. In the wet season the markings are distinct and vivid, in the dry season they are obscure and pale, thus aiding the butterfly in camouflage among dried leaf-litter. The male and female look similar.

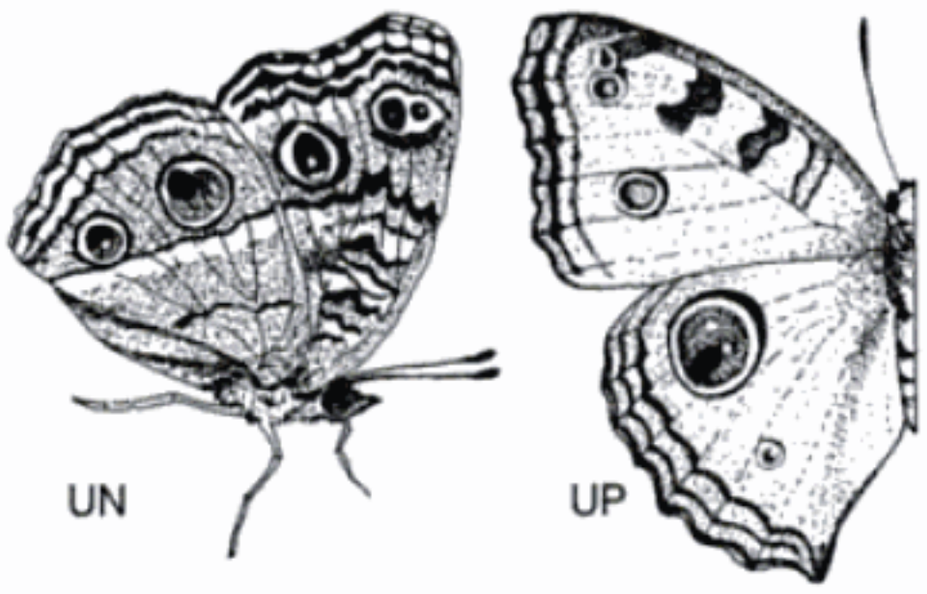


Lemon Pansy UP

Medium-sized, brown with eye-spots and lemon yellow and black markings

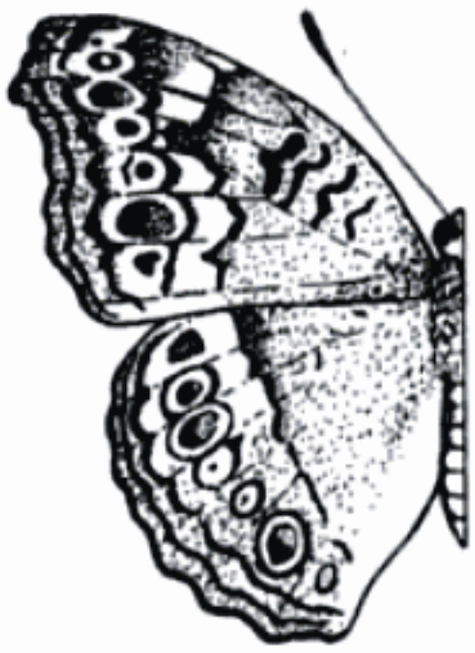
Other Species of Pansys There are five other species of Pansy, all very common. Their breeding and general habits are also similar, but their habitats are different. These species are as follows:

1. **Peacock Pansy** (*Junonia almana* Linnaeus) (Plate 19, no. 110) Bright and tawny with large eye-spots on the wings. It is found near water-bodies.



Peacock Pansy (wet season form)

2. **Grey Pansy** (*Junonia atlites* Linnaeus) (Plate 19, no. 111) It is creamish-grey with brown lines and a row of black spots near the wing margin. It is found near water-bodies.



Grey Pansy UP

3. **Blue Pansy** (*Junonia orithya* Linnaeus) (Plate 19, no. 109) Its hind wings are brilliant blue. The fore wings are brown and black with two distinct white bands. It is found in dry, open areas.

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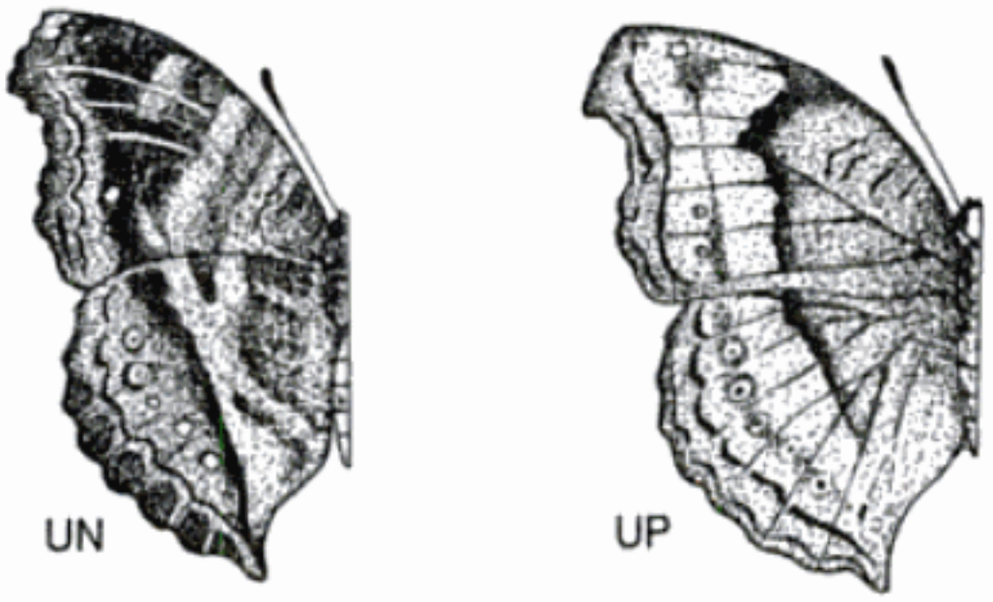
Blue Pansy UP

4. **Yellow Pansy** (*Junonia hierta* Fabricius) (Plate 18, no. 108) It is predominantly yellow. Its fore wing apex is black with yellow spots. The hind wings have a large blue spot. It is found in dry areas and stony stream-beds in deciduous forests.

Yellow Pansy UP

5. **Chocolate Pansy** (*Precis iphita* Cramer) (Plate 19, no. 112) It is chocolate-brown with darker markings. It is found in wooded areas and forests.

The dry season forms of the Chocolate and Peacock Pansy with their undersides exposed are marvellous mimics of dried leaves.



Chocolate Pansy

Status, Distribution and Habitat The Lemon Pansy is among the commonest butterflies in gardens, fallow lands and open wooded areas. It is found almost throughout the year. Although it is more numerous during the monsoon and post-monsoon months, it maintains some population in cold and dry seasons as well. It is distributed in the Indian subcontinent, extending up to Malaysia in the east.

Habits This is a very active butterfly. In the morning it is seen basking on low-growing herbs or on the ground. It rests with its wings spread flat and facing the sun. However, every now and then it changes its position or place. Afterwards, when it starts its activity, it selects a vantage point such as an outcropped branch and keeps an eye on the trespassing butterflies which it chases away. This habit is most pronounced in the Chocolate Pansy, but is also seen in all other species to various degrees. Once in a while it slowly moves its wings up and down, while thus perched.

It is also an active feeder. It takes great delight in visiting flowers of *Lantana, Cosmos* or other large flowers with abundant nectar. While feeding, the wings are kept half-open.

The Lemon Pansy, like the other Pansys, is very easy to approach, but it keeps a certain distance. If one goes too close, it darts ahead with rapid wingbeats, but settles soon and not very far away. It always flies close to the ground, wanders around for some time but may return to the same place. However, it is able to disperse effiecintly and easily. Annual fires are a common phenomenon in Indian forests and grasslands. After the fire destroys the ground vegetation, this is one of the first butterflies to appear in the burnt areas, usually within a week or so.

Reproduction The eggs are laid singly, usually on the undersides of leaves. The egg is green and barrel-shaped with longitudinal, finely-beaded ridges. The caterpillar is cylindrical and uniformly thick from the head to the abdominal tip. It is black with a faint

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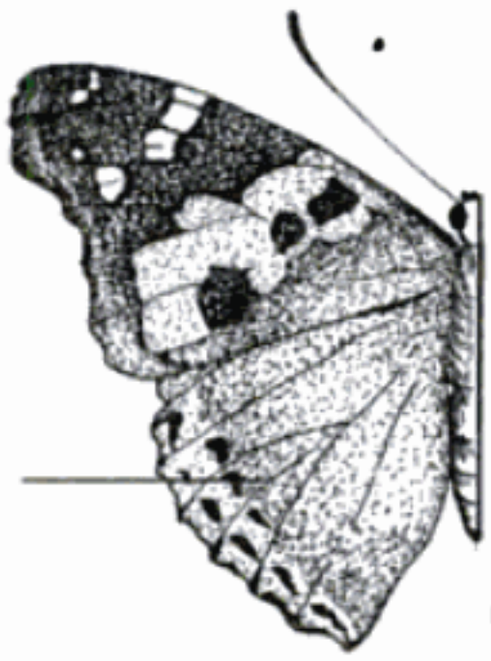
with grey, black, white and a few red spots and lines. Although it is widely distributed and found in many habitats, the individuals do not vary in either colouration or markings, but they do vary considerably in size. The sexes look similar.

Similar Species The Indian Red Admiral (*Vanessa indica* Herbst) looks similar, but its hind wing is plain brown, except the border and the wings have fewer markings as compared to the Painted Lady. In peninsular India, it is restricted to montane grasslands and edges of sholas in the Western Ghats, but widely distributed in the Himalayas and Eurasian region.



Indian Red Admiral

Status, Distribution and Habitat It is possibly the world's most widely distributed butterfly. It occurs on all continents except South America and Antarctica. It is found at a wide range of altitudes from coastal plains to the top of Anaimudi in the south and at over 4,000 m in the Himalayas. It uses a variety of habitats. However, it prefers open areas and grasslands, including montane grassy meadows, with sparse grass and abundant herb cover. It is found in considerable numbers on open hill-slopes and plateaus, where one of its larval host plants, *Zornia gibbosa* grows abundantly. It also penetrates moist deciduous and evergreen forests along the roads. It is abundant in its preferred habitat during the monsoon and post-monsoon season, but absent during the dry period. In other habitats its occurrence is seasonal and sporadic.

Habits In the morning the Painted Lady is often seen basking on the ground revealing its attractive colours. However, it is wary and keeps a safe distance. After basking it becomes very active and flies around in search of flowers—its most loved food source. In spite of its bright colours it is difficult to follow, even visually, owing to its swift flight and rapid wingbeats. Added to this is its habit of halting abruptly during flight, when it sits on the ground with its wings closed and the fore wings half-drawn between the hind wings, thereby camouflaging itself well. The markings on the underside of the wings look very prominent when one sees the butterfly in hand. However, they disrupt the outline of the butterfly so well with the gravelly, partly vegetated soil that it is quite a job for even an experienced butterfly-watcher to locate it once it hides itself in this manner. Then it suddenly rushes out, flies rapidly and settles farther away. However, it always flies close to the ground in open areas, may be because in these areas all the vegetation is restricted to within a metre from the ground. In forested, woody habitats, it also perches on bushes but prefers to keep closer to the ground.

One very peculiar phenomenon seen in this species is the complete exploitation of available larval host plants from an area. This leads to short-distance or long-distance migrations of the adults (see the section at the end of "Reproduction"). This happens frequently and therefore the species is a regular migrant. This habit of migration explains the lack of colour variation and absence of subspecies or races in this species. As individuals in an area are never isolated from those from other areas, there is frequent mixing of genes, which prevents the formation of subspecies.

Reproduction The female lays eggs singly, generally on the underside of herbs that are in the vegetative stage, that is, before flowering. When a bushy plant is chosen, the eggs are laid on young shoots. The egg is a beautiful pale bluish-green colour and vertically ribbed. Since the usual larval host plant, *Zornia*

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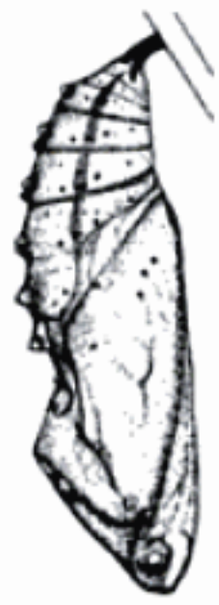
gibbosa, is very common, the eggs are laid carelessly, sometimes on other plants, or even on rocks and on the ground. The little caterpillar, however, is an expert botanist and always chooses the right plant. It stays in a loose leafy home, or 'cell', which it makes by weaving together leaves of its host plant with help of the silk it produces. It makes ventures out of this home for short periods to feed on nearby leaves. It continues to lead such a secretive life throughout its larval stage. Occasionally it changes the cell as it devours all surrounding leaves or makes a bigger cell to accommodate its ever-increasing mass. Before pupation, it leaves the cell permanently and finds refuge under a rock or a small bush.

In the wooded habitats where the caterpillar may feed on leaves of large shrubs or trees, it makes the cell out of young leaves. Here it also feeds on the same leaf of which the cell is made. Through the cell, the caterpillar may be seen sitting with its head turned round on one side. It jumps out of it and in the air if the need arises, such as when a predator threatens.

The caterpillar is velvety and varies in colour, from light red-brown to black. The body is covered with translucent white spines, the branches of which are black. The spines arise from conical, rosy tubercles. A single lateral and double dorsal yellow line may be present, but this is inconsistent in different instars and regions. The head is dark brown or black, shiny and lacks horns.

The pupa is similar to that of a Pansy, but more slender. The colour of the pupa, just as in the case of the caterpillar, varies between shades of yellow, green and pink, all of which are suffused with brown to varying degrees. The abdominal segments have small tubercles. The pupa is situated on the underside of the support from which it hangs and is slightly bent towards the support.

Sometimes large numbers of females concentrate their egg-laying efforts in a small area. The caterpillars, then, do not leave a single green tissue on the host plants. In the process if food gets scarce, many of them die, or pupate very early. The adults that emerge out of these pupae migrate to other areas to find fresh fields of host plants for their caterpillars. Sometimes, these migratory swarms can be huge. Those in Mexico and neighbouring regions have been estimated to be constituted of billions of individuals. One can only imagine the vastness of these swarms. I have seen local movements in western Maharashtra, which were a result of very high density in one area. The density of newly-emerged butterflies on one particular morning was over one butterfly per square metre. The actual density of butterflies that would have emerged as a result of that particular breeding frenzy, as estimated by counting the number of fresh pupae in a unit area, was between 2 and 3 butterflies per square metre. All the caterpillars had barely managed to grow to the size that was necessary to be able to pupate. By the time the caterpillars pupated there was no trace of *Zornia* left in the area and the ground was covered with a distinct layer of dark-green droppings of the caterpillars. The resulting butterflies were dwarfed beauties, almost half the size of normal butterflies, but twice as bright. They dispersed in neighbouring areas where they could easily be distinguished from other individuals by their size and colouration.



Length of caterpillar: 40 mm. Length of pupa: 24 mm.

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Larval Host Plants Being such a widely distributed species, it feeds on a variety of plants belonging to many families. Within Indian limits, *Artemisia* spp., *Blumea* spp., *Debregeasia bicolor, Gnaphalium* spp. and *Tricholepis* spp. are reported, besides *Zornia gibbosa* which is most common, but "probably many others" (Wynter-Blyth 1957). The actual list may run into a few dozen species.

42. Danaid Eggfly

(Plate 19, no. 114 and Plate 21, no. 123)

Scientific Name *Hypolimnas misippus* Linnaeus.

Field Characters Wingspan: 70–85 mm. The Danaid Eggfly is a superb example of sexual dimorphism. The female is an excellent mimic of the Plain Tiger. It is tawny with the apex of the fore wing coloured black and with a white band. The borders of the hind wings are black with a series of white spots. The underside is similar but paler. The male is jet-black above, which is thrown into contrast by two glistening white oval spots—a large spot on the hind wing and a small one on the fore wing. Near the tip of the fore wing is another smaller white spot. The underside is light rusty-brown with a golden-yellow tinge. A broad white band on the hind wing and a narrow one on the fore wing are distinct.

Medium-sized, tawny with black apex and white band. Mimics the Plain Tiger.

Medium-sized, black with white spots

Similar Species The female can be distinguished from the Plain Tiger by the following characteristics: i) more reddish wings ii) a large black spot near the front margin of the hind wing, compared to the Plain Tiger's 3 or 4 smaller black spots iii) the pattern of the pied wing margin is different (compare the illustrations). The Common or Striped Tiger differs in having distinct black stripes on the wings.

The uppersides of the male Great Eggfly (*Hypolimnas bolina* Linnaeus) (Plate 20, no. 115) and Danaid Eggfly are similar and some old specimens may be confusing. The Great Eggfly has a series of white dots near the margin, which the Danaid Eggfly lacks. On the other hand, the Great Eggfly lacks the Danaid Eggfly's pointed fore wings and the grace with which they are held. The large white spots of the Great Eggfly are suffused with purple, but those of the Danaid Eggfly

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Dark Blue Tiger

Glassy Tiger

Nilgiri Tiger

wing-margins of the same colour. The Common Mime (form *dissimilis*) also looks similar but is larger and found in forested habitats. Its markings are composed mostly of stripes and a series of creamy yellow spots at the outer margin of the hind wing is prominent.

Status, Distribution and Habitat The Blue Tiger is found at all altitudes and in almost all habitats, natural as well as modified or created by man. However, it avoids very dense forests and arid areas. It is very common during the monsoon and post-monsoon months, rare or locally absent in winter and summer. It is distributed throughout south and southeast Asia except the Sunda islands.

Habits This is a typical Tiger butterfly—large, showy and slow-flying. The flight is fluttering with intermittent spells of sailing. It is fond of wet soil and nectar. It relishes nectar from hedges of exotics such as *Cosmos, Tagetus* and *Lantana* and visits gardens for these plants. At the forest edges, tall herbs such as *Adelocaryum* attract this butterly and dozens of individuals gather on it. The wings are closed over the back while the butterfly feeds.

In the dry months, hundreds of males may assemble at water-holes. They keep sailing around, looking for new spots to drink water and cluster together at the mud-puddling spot.

Males of this and other Tiger species need an alkaloid source to maintain their stock of mate-attracting chemicals, or "sex pheromones". These sources are certain plants, *Crotalaria, Heliotropium, Ageratum,* which contain the alkaloids in relatively higher quantities. The Blue Tiger, along with the Crows and tawny Tigers, swarm over damaged parts of these plants from where the sap oozes out.

This species migrates occasionally. A few hundred to a few thousand individuals may participate in the migrating swarms, but usually other species outnumber it in such swarms.

Reproduction The males may congregate at a place, such as a stream-bed, where they attract the females for mating. The males have a brush at the tip of the abdomen. They protrude it out and stroke the pouches of specialized scent scales on the hind wings to scatter the scent that attracts the females.

After fertilization, the eggs are laid in a fashion similar to that of the Plain Tiger. The egg is also similar. The caterpillar lives on the underside of the leaf. Until the second instar the tentacles (this species has two pairs) are relatively short and hence indistinct. During this period the caterpillar is very soft, smooth and shiny. Its colours are not bright. In the next instar, the tentacles become distinct. The first pair is on the 3rd segment and the other on the 12th, the first being longer and moveable. The body is banded with black, greenish-yellow and white rings. A distinct yellow, fleshy spiracular line runs from the second segment to the last. The spiracles are large, black and oval. The underside of the caterpillar is whitish, with a greenish tinge and marked with white bands and blotches. The head also has black and white oblique stripes that are placed alternately.

The pupa is fresh green and shiny, with a shape similar to that of the Plain Tiger. It is

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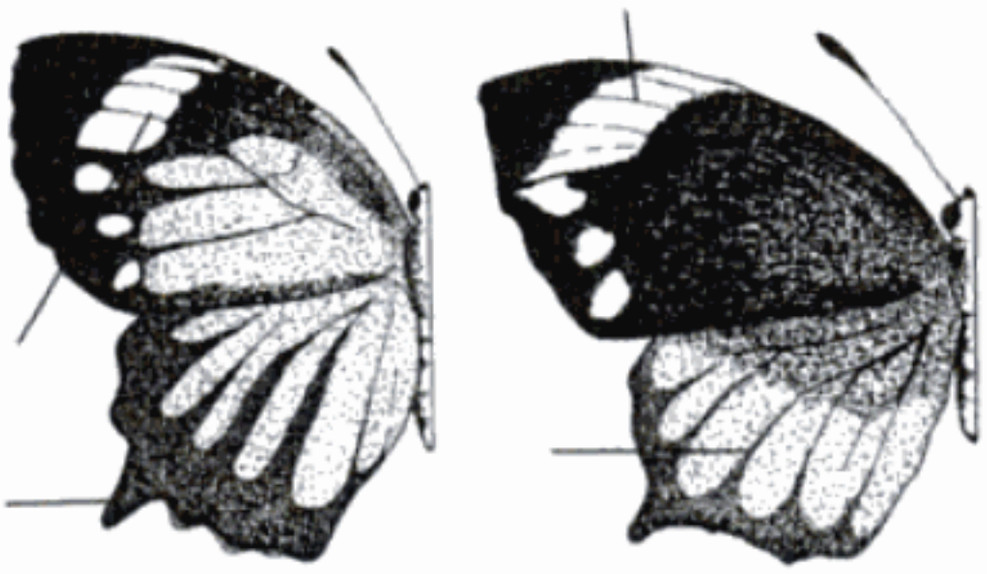
encloses a series of semicircular white spots. The butterfly is somewhat oily and smooth to touch. The male is smaller than the female.

Similar Species The Plain Tiger may be easily confused with the female Danaid Eggfly (see the Danaid Eggfly for distinguishing characters and Plate 21, no. 123). The Common or Striped Tiger is larger, much more richly coloured and has broad black stripes on the wings. The Common Palmfly (*Elymnias hypermenstra* Linnaeus) (Plate 21, no. 126) female may also look similar, but it has a broader black border and black stripes



Female UP Male UP

Common Palmfly

Indian Fritillary female UP

on the wings. Its maroon underside is heavily marked with white streaks. It is usually found near forests or palm groves. The Indian Fritillary female has black spots on the wings and a green underside. It occurs in the montane grasslands of the southern Western Ghats.

Status, Distribution and Habitat Clearings and edges in open forests, scrub and savannahs, neglected corners and gardens in human habitations and riversides are the best places to look for this butterfly. These are the places where the 'aak' (*Calotropis gigantea*) and *Asclepias curassavica*, two of its commonest host plants, grow in abundance. The adult nectar sources are also found in ample quantities here. The constant disturbance to vegetation around human habitations favours these host plants of the Plain Tiger, which are now omnipresent throughout the Indian subcontinent. However, it occurs mostly in low elevations. It never occurs in large numbers, although it is common throughout the year. It is more common during the monsoon and just after it, but persists even through the summer. Its global distribution extends over Africa, most of Asia and parts of the Australian region.

Habits The Plain Tiger is protected against attacks from avian and reptilian predators by virtue of the unpalatable alkaloids it ingests during its larval stage. Its bright colours advertise its unpalatability. Its flight is slow and laborious. This gives its predators sufficient time to recognize it. Inexperienced predators may try it out, but learn quickly, as the alkaloids stored in the butterfly's body cause vomiting. To survive such occasional attacks the Plain Tiger has a tough, leathery skin and is therefore difficult to kill. It shams death when caught and smells and tastes nauseating. After it is released, it immediately resumes flying.

It flies straight and close to the ground with few vertical deviations. However, flowers attract it, nectar being its only nourishment and it visits plants like *Lantana, Tagetus, Cosmos* and garden plants very often. When at rest, the wings are closed over the back. However, the newly-emerged specimen, still too wet and soft to fly, flaps them slowly to reveal the brighter colours on the upperside. This is probably a behaviour that warns the intruders of the butterfly's foul taste.

While basking, it rests close to the ground, on small bushes, etc. and spreads its wings with its back towards the sun, so that the wings are completely exposed to the sun's rays.

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Reproduction The male courts the female by hovering over it with light wing-beats.

To lay eggs, the female perches at the edge of a leaf, curls its abdomen to reach the lower surface and lays a single egg at a time. Therefore, the egg is always near the margin on the lower side of the leaf. The female may lay well over half-a-dozen eggs on the same plant, especially on a large bush of *Calotropis*, but never more than one on a leaf. This is to avoid overcrowding by the growing caterpillars. The egg is silvery-white and shiny. It is tall with an apical point and ribbed sides. After the caterpillar hatches, its first meal is of the eggshell itself. It then starts feeding on leaf tissues. It lives all its larval life on the underside of the leaves. During the first few days it eats only lower tissues of the leaves, leaving the upper cuticle and layers beneath it untouched. When its mandibles grow large enough, it devours the leaves by gnawing at the edges.

The caterpillar is cylindrical and of almost uniform width from the head to the abdominal tip. Its most striking characteristics are a banded body and three pairs of long and black tentacles—the first on the 3rd segment, the second on the 6th and the third on the 12th. The first pair is the longest and moveable. The head is shiny, smooth and black. Initially the caterpillar is yellowish with black bands on it, but later it turns a dark chocolate-brown or black with alternate, narrow whitish and yellowish bands and a series of dorsolateral, rather longish yellow spots. There is a yellow spiracular band, upon which distinct black spiracles are present. The legs and prolegs are black. The prolegs have white bands at their bases.

The pupa hangs freely from the support. It is widest at the 7th segment (abdominal segment) where it has a double chain of extremely tiny golden and black beads. There are tiny golden spots on the shoulders and wing-cases. The rest of the pupa is pale green with a smooth surface. The pupa is light pink when formed among dry or unnatural objects, such as the ones provided under captive conditions.

The Plain Tiger caterpillars often become living storehouses of food for the larvae of Ichneumon wasps and parasitic flies. The parasitic flies are particularly notorious. Only a single fly larva feeds inside the caterpillar. At the time of pupation, when the caterpillar is suspended upside down to shed its moult, the parasite larva makes its way through it by boring out of the skin. It crawls out and away into the soil. It pupates amongst the loose top soil or humus, camouflaged by its brown pupal colour. The parasite puparium is segmented and has two projections on top of the head. The fly that emerges from the pupa is smaller than the common house fly, black with a very hairy abdomen. Meanwhile, the Plain Tiger caterpillar pupates normally. However, soon it turns dark brown as the internal tissues start decaying.

Length of caterpillar: 38 mm. Length of pupa: 18 mm.

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Larval Host Plants The caterpillars feed on "milkweed" plants. These, in our region, include a large bush—*Calotropis gigantea*, a herb growing in the vicinity of water—*Asclepias curassavica* and a straggling bush—*Cryptolepis buchnani* (Asclepiadaceae). The first two are commonly used.

Suggestions for Student Projects See the Tailed Jay for the suggestions.

45. Striped or Common Tiger

(Plate 21, no. 124)

Scientific Name *Danaus genutia* Cramer (Old: *Danais plexippus* Linnaeus)

Field Characters Wingspan: 72–100 mm. The wings are tawny with broad and black veins, giving it a striped appearance. The margins of the wings are black with two series of white spots. The underside is similar in colour and pattern, but paler, as compared to the upperside. The male has a black-and-white spot on the underside of the hind wing.

UP

Male
UN

Medium sized to large tawny with white band and black stripes

Similar Species The Plain Tiger lacks the black veins. The Common Palmfly has a red-brown underside streaked with white and a tooth on the hind wing. The Tamil Lacewing is more richly marked on the underside, with the markings broken up into spots.

Status, Distribution and Habitat It is common in scrub jungles, fallow lands around human habitations as well as dry and moist deciduous forests, but prefers areas with moderate to high rainfall. It also occurs on ridges and hill-tops covered with secondary scrub or denuded of forest cover, as well as in bare land. It is most active from the pre-monsoon to the post-monsoon period, but individuals may turn up in other seasons as well. It is distributed throughout India and rest of the Indian subcontinent, extending to southeast Asia and Australia, but absent in New Guinea.

Habits It is a strong flier, but never flies fast or very high. The wingbeats are regular and fairly rapid, as compared to the Plain Tiger. The nectar and alkaloid resources seem to dictate the movements of this butterfly and it is a common visitor to urban gardens. It feeds from the flowers of *Lantana, Celosia, Adelocaryum, Cosmos, Zinnia* and many others, which grow either in gardens or at forest edges and on hill slopes. The wings may be kept open or closed while feeding from flowers.

The males participate in large congregations of Danainae to sip the sap from *Crotalaria, Heliotropium* and other plants that provide

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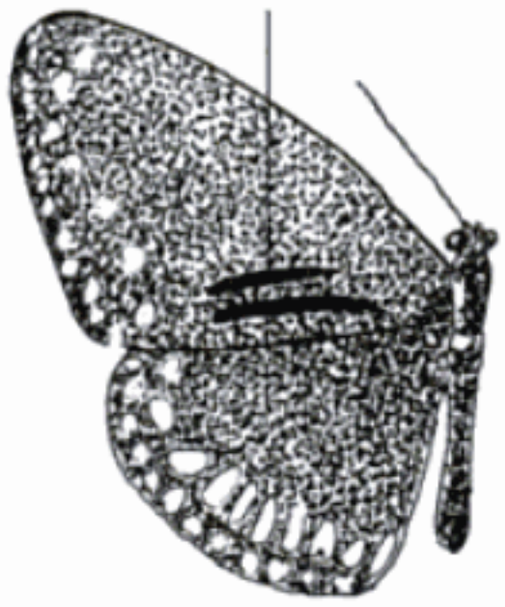


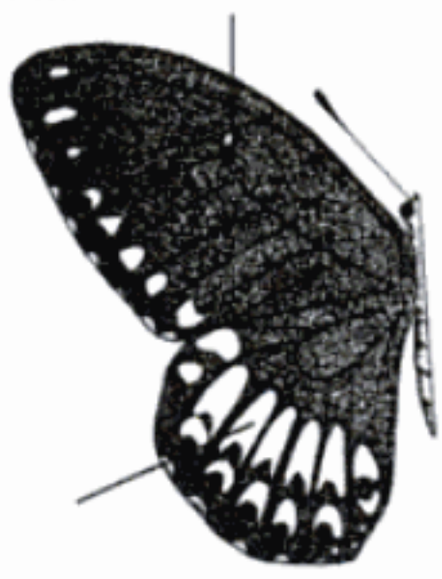
UP

Double-branded Crow

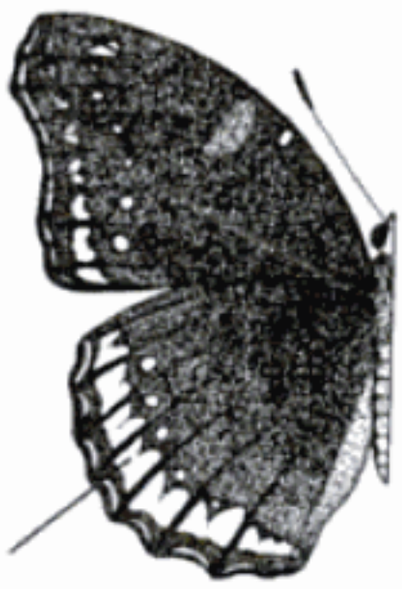
same genus) and Müllerian mimics. The Malabar Raven (*Papailio dravidarum* Wood-Mason) and Common Mime (form *clytia*), both Swallowtails, and the female Great Eggfly are Batesian mimics. The distinguishing characters of all these species are as follows:

1. **Double-branded Crow** The male has two brands and the female has two short, whitish streaks. The male Common Indian Crow has only one brand and the female only one streak.
2. **Brown King Crow** In the male, the middle portion of the upper fore wings is brownish yellow. Near the lower margin of the fore wing is a broad brand. The female has an indistinct white streak on the underside of the fore wing and the white spot in the cell is absent (present in the female Common Indian Crow).

   All these characteristics are visible only when the butterfly is captured and carefully examined. All the species have overlapping distribution ranges and habitats. However, the last two species are local and not common.
3. **Great Eggfly Female** (Plate 22, no. 129) It may be readily distinguished by its broad wings and usually larger size (wingspan: 70–110 mm.). It has a blue sheen on the upper fore wings and has notched white markings in place of the round spots of the Crow.
4. **Malabar Raven and Common Mime** Being Swallowtails, these have three pairs of long legs, instead of two relatively short ones as in the Common Indian Crow. These are easily noticeable when the butterflies are at rest. Also, the inner row of spots is very long and pointed at the inner end in both these species. The Common Mime has an additional row of cream-coloured spots at the margin of the underside of the hind wings. The Malabar Raven (Plate 22, no. 130) has a white spot in the fore wing cell, which is distinct on the underside. These species are found only in the forests. The Malabar Raven is endemic to the Western Ghats south of Goa. The Common Mime is distributed in all forested areas in the Western and Eastern Ghats, central Indian hills, Himalayan foothills and northeast India.



Malabar Raven UP



Great Eggfly Female UP

Status, Distribution and Habitat This species thrives in all habitats—in scrub, near human habitations and forests of all kind and from sea-level to over 2000 m. It is rare in very dry areas and thick evergreen forests, but penetrates such forests through open streams and large paths. It is one of the most abundant species among the Tigers and Crows and is generally quite common. It is active throughout the year, with some seasonal variations in numbers, depending upon local conditions. The global distribution extends over the entire Oriental and Australian region.

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has four pairs of tentacles—on the 3rd, 4th, 6th and 12th segments. The first is the longest and moveable. All of them are curved backwards at the tips. When disturbed, the caterpillar rolls the head and thoracic segments towards the underside, and sways sideways if disturbed further. The pupa of this species is one of the most wonderful sights in nature. It is lustrous, golden, compact and very easy to locate due to its colour. Its wing-margins and abdominal segments are marked with broad, colourless bands. Two humps, one on the back of the thorax and the other on the abdominal segments, are distinct. On the dorsal side, the abdomen has a pair of black dots on each segment. The cremaster is black.

The caterpillars are attacked by parasitic flies.

Larval Host Plants The larval host plants of this butterfly are numerous, but usually some preference for a certain species exists at any given place. The most commonly used plants are *Ficus racemosa, Nerium odorum, N. oleander* and *Cryptolepis buchanani.* Other reported host species include *Ficus benghalensis, F. religiosa, Hemidesmus indicus, Holarrhena pubescens, Ichnocarpus frutescence* and *Tylophora indica.* They belong to three different families: Moraceae (figs and kin), Asclepiadacea ("Milkweeds") and Apocynaceae (oleanders and allied species), but all have milky unpalatable latex.

47. Malabar Tree Nymph

(Plate 22, no. 132)

Scientific Name *Idea malabarica* Moore
(Old: *Hestia lynceus* Moore and de Niceville)

Field Characters Wingspan: 120–160 mm. This is one of the largest Indian butterflies. The wings are translucent and dirty grey-white, spotted and streaked with black. The underside is similar to the upperside in markings. The sexes are similar.

UN

Very large, white with black spots

Status, Distribution and Habitat This species occurs Goa southwards in the Western Ghats and is endemic to this area. It is confined to the low and mid-elevation, wet evergreen forests. It occurs very commonly in the monsoon and post-monsoon months, but is active throughout the year.

Habits It is a sociable butterfly, seen mostly in small parties of 4–5 individuals. Single individuals are not rare, but there will always be other single individuals in the vicinity, thus forming loose groups.

This is one of the slowest of Indian butterflies. It scarcely moves its wings while gliding and when it flaps, it is only a gentle movement. It floats everywhere in the forest, in the canopies and near the ground, its flight being as effortless and comfortable at all times.

It visits flowers to feed but never comes to wet soil.

At rest, it closes its wings and sits on exposed branches.

Reproduction During the courtship flight, the male chases the female zestfully, gliding in a zigzag manner and also up and down.

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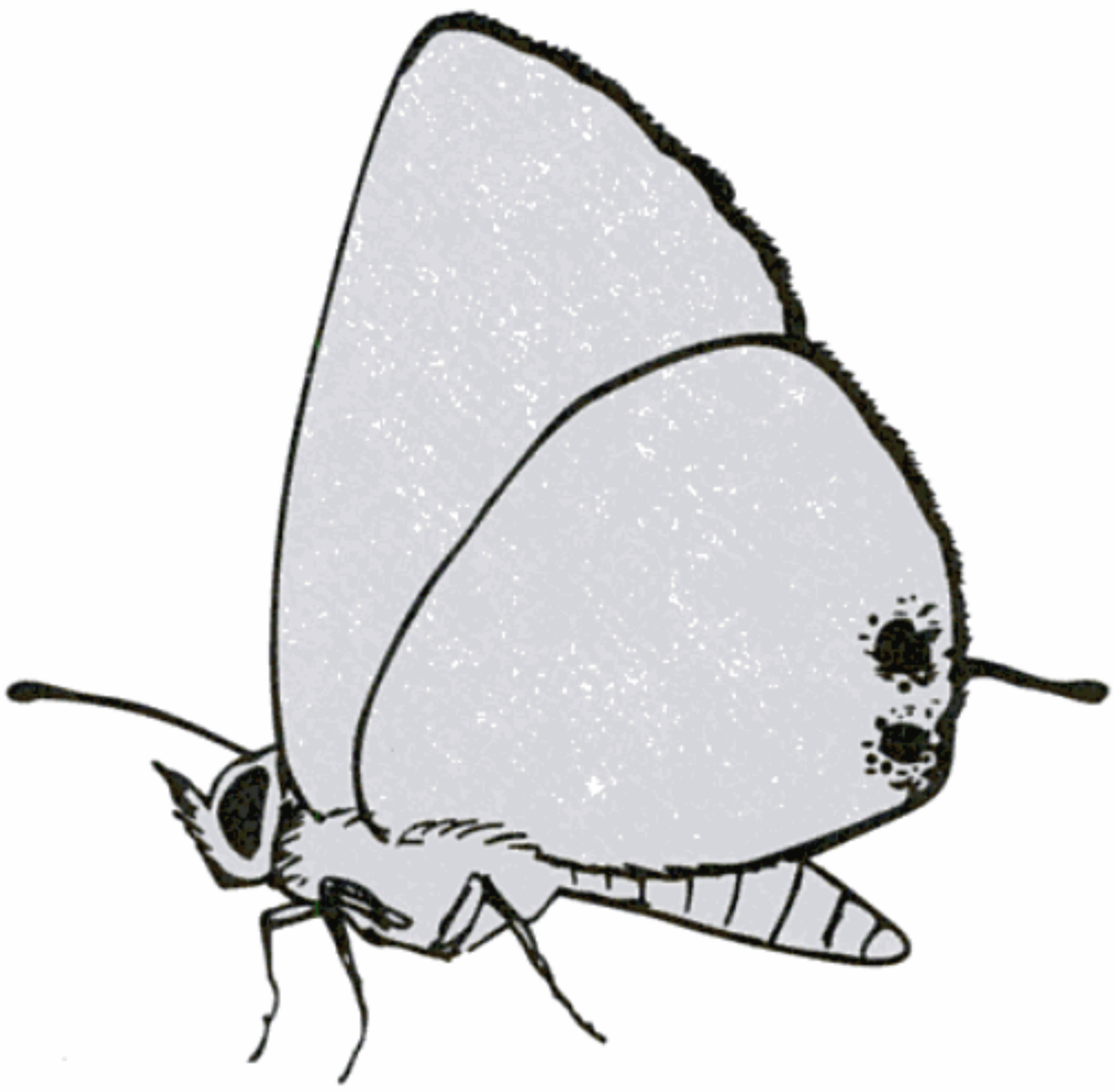

5.4 Family Lycaenidae

Blues

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Family Lycaenidae

The family Lycaenidae, or "Blues", is the world's largest family of butterflies, along with Nymphalidae, with about 6,000 species. This froms a third of the globe's butterfly fauna. India has approximately 450 species, which is 21% of its total number of butterfly species. Over a 100 species are reported from peninsular India. Within India, the greatest diversity occurs in the Western Himalayas and northeast India.

Blues are small butterflies, the exceptions being the Oakblues, some of which may be large. They are usually shades of blue and purple on the upperside (hence their English family name, the "Blues"), brown or white on the underside with spots and lines of darker colours.

The sexes are often different in appearance. The males are metallic blue, the females paler blue or brown with scattered blue scales. The males have narrow borders on the uppersides of their wings, and the females have broader borders. However, they are similarly marked on the undersides.

Among peninsular Indian Blues, seasonal variation in form and markings is rare and subtle. In the Common Cerulean, however, it is very prominent, with individuals in the dry season form being light brown, instead of whitish-gray and marked with bands, rather than with lines.

Their habitats are somewhat specific to subfamily, hence, given under the subfamilies.

The males regularly bask with their wings spread out and the upper surfaces of their wings facing the sun. The females also do so, but spend a lot of their time in finding suitable larval host plants as well.

These butterflies feed on a variety of resources. Many of them, for example, the Grass Blues, the Pea Blue and Ceruleans, visit flowers. The Hedge Blues and Lineblues are drawn to droppings of birds and smaller mammals. Some also feed on tree-sap. The males of many species, for example, the Oakblues, Pea Blue and Lineblues, come to wet soil. However, unlike Swallowtails and Whites and Yellows, they usually do not form very large assemblages, but feed singly or in very small groups.

Only a few species are migratory or have local movements. A good example is the Pea Blue. It moves locally, sometimes even migrates to somewhat long distances. The exact causes and patterns of these movements are yet unknown. The availability of ephemeral larval host plants is probably the key factor governing these movements.

Most Blues have evoked two important mechanisms to protect themselves. The first is the presence of tails on the hind wings of adult butterflies, the second is the association of caterpillars with ants that protect them. The tails of most Blues are short, slender and thread-like and complemented by lobes at their bases. The lobes or their immediate surroundings usually have black and golden spots surrounded by patches of orange scales. These, together, may resemble the head and antennae of the butterfly, or at least look more prominent than the actual head. Therefore attacking predators, usually birds or lizards, first instinctively bite or peck at the tails and the lobes, while the alarmed butterfly shoots forward and out of reach. Since the wings are soft, their parts break off, but the butterfly's life is saved. Individual Blues with tails and lobes or large portions of their hind wings bitten off are not uncommon and each of these individuals probably represents a life saved due to this adaptation. The other trick of self-protection, that of association with ants, is discussed in section 2k.Adaptations to Escape Threats: Association with Ants.

The reproductive habits of this family are varied, but some generalities are found. The eggs are laid singly on young leaf-shoots, flower buds and fruits or pods. Those of the insectivorous species (for example the Apefly, see below) are laid among prey insects. The

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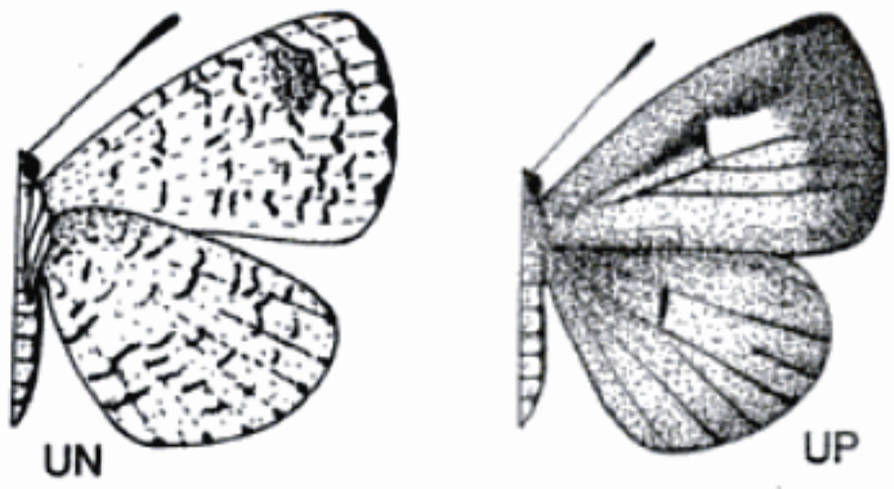
species that heavily depend upon ants for protection of their caterpillars lay their eggs among the ants. The eggs are turban- or disc- or dome-shaped, sculptured and pitted, with a prominent micropylar pit on top. They are usually white or pale green. In some species, they may yield caterpillars only after a few months if the conditions are not favourable for the growth of the caterpillars.

The caterpillars are roughly woodlouse-shaped. They vary in colour, but are usually shades of green and brown marked with dark or pale longitudinal lines. Their heads are hidden under the 2nd segment. A loose sheath of skin covers the body and even the legs, which can be seen only obscurely. The skin is smooth, usually with a coat of sparse, minute tubercles and hair. On the upperside, there is a mouth-shaped gland on the 11th segment and a pair of pillar-like organs on the 12th segment. Most caterpillars feed from the outside, but a few bore inside young shoots and fruits. A few species hibernate in the larval stage.

The pupae are not very smooth and may be slightly granular. They are rounded in front, have a small hump on the thorax, with another larger hump on the abdomen. They are brown or green, made inconspicuous by pale or dark brown spots and dustings of smaller dots. They are placed on or beneath the leaves, twigs, in the fissures of a bark, among flowers or pods, on the ground or among leaf-litter. They are strongly or loosely attached by cremaster, usually supported by body-bands.

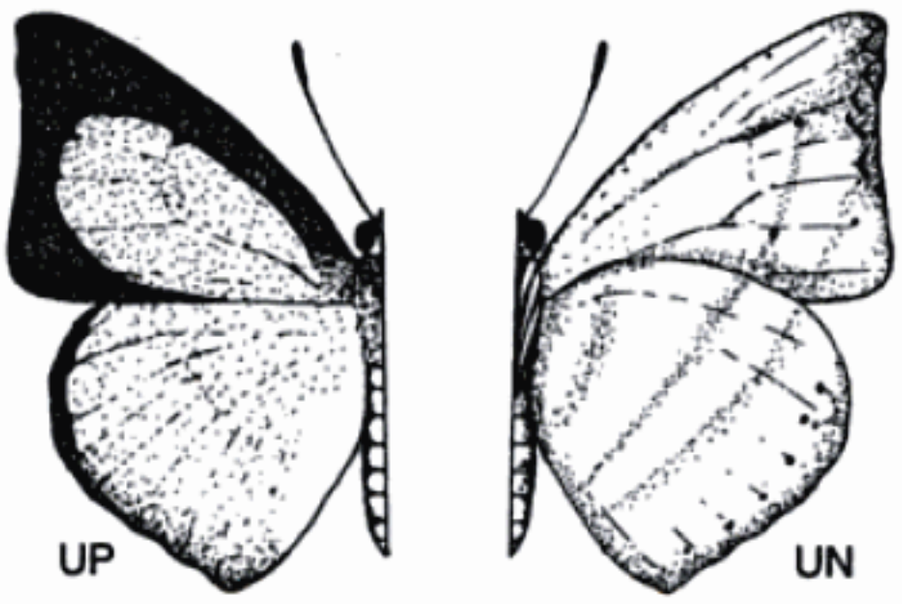
Peninsular Indian species are classified into 5 subfamilies, and some of their prominent characters are as follows:

1. **Subfamily Miletinae** There are only two species in peninsular India: the Apefly (*Spalgis epius* Westwood) and the Mottle (*Logania distanti* Semper). These are small, dull-brown and white butterflies, inhabitants of wooded areas. The caterpillars are remarkable in their feeding habits. They feed not on plants, but on small, often powdery, relatives of bugs—the mealy bugs and scale insects. The ants do not attend to them.



Apefly

2. **Subfamily Curetinae** (The Sunbeams) There are three species in peninsular India and they all look similar. The males are red and the females white with black borders. They are inhabitants of wooded areas. The males are much more frequently seen than the females and usually near wet soil. The caterpillars feed on leguminous plants. Their organs on the 12th segment are permanently exserted.



Sunbeam

3. **Subfamily Theclinae** ("Strong Blues") It includes Oakblues, Leaf Blues, Silverlines, Royals and Flashes. It is represented in peninsular India by approximately 45 species. The members of this subfamily have a big thorax, a relatively small abdomen and mostly large and pointed wings; therefore, the butterflies have a strong flight. The males are more brilliantly coloured than the females. The Oakblues lack scent scales, others may have patches of modified scales on the upper fore wings. In India, this subfamily has a maximum number of representatives

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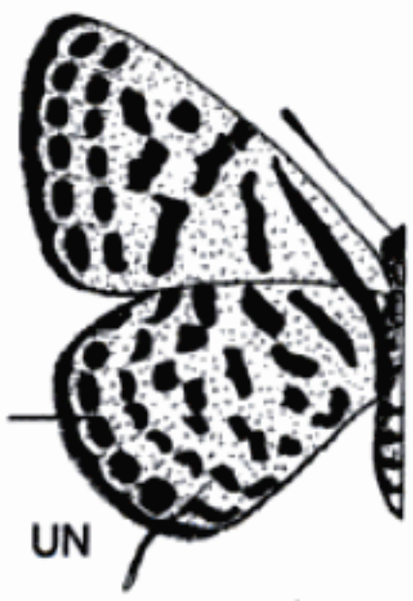
Very small, white with black markings and a metallic green spot

Similar Species The Dark Pierrot (*Tarucus ananda* de Niceville) has similar markings on the underside, but lacks the unmarked gap at the centre of the hind wing margin and the central region of the hind wing. On the upperside, it is dark and purplish. The Angled Pierrot (*Caleta caleta* Hewitson) (Plate 23, no. 134) and the Banded Blue Pierrot (*Discolampa ethion* Doubleday and Hewitson) (Plate 23, no. 135) are slightly different, but similar to each other. They have two black bands on the underside of the fore wing at the cell, which form a marking that resembles a 'V'. In the former, the arms of the V are at an angle of 90° and in the latter they are very close to each other and almost parallel. All these species are found in moist deciduous, semi-evergreen and evergreen forests, especially along the forest streams.

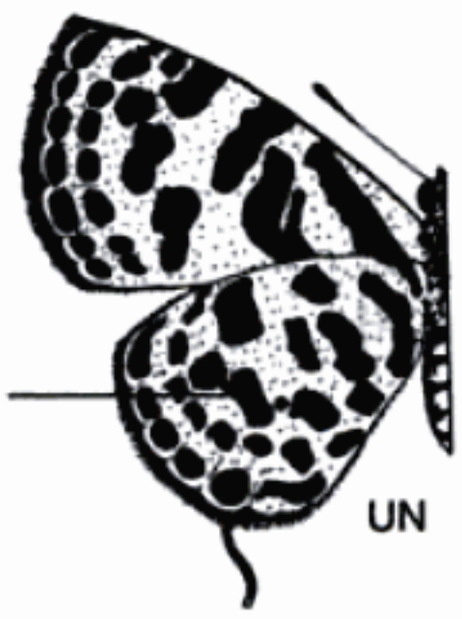
A few other species of Pierrots, for example, the Rounded Pierrot (*Tarucus nara* Kollar) (Plate 23, no. 136), cannot be mistaken for this species although they are white marked with black. These species have more than three metallic green spots at the lower corner and hind wing on the underside. However, it is not possible to distinguish between those species in the field because their markings are similar and only the genitalia structures are different. These species occur in semi-arid areas or highly disturbed dry forests.

Banded Blue Pierrot

Angled Pierrot



Rounded Pierrot



Dark Pierrot

Status, Distribution and Habitat The Common Pierrot is indeed common, especially in open deciduous forests, scrub, grasslands interspersed with trees and near human habitations. It co-occurs with its larval host plants—*Ziziphus mauritiana* and *Z. rugosa*. It occurs in lowlands and mid-elevation areas. It is most common during the monsoon but is active in all seasons. Its distributional range extends over the Indian subcontinent and to southeast Asia.

Habits This is a weak flier and it is puzzling how it evades predation by birds. Added to its bright pied colouration is its habit of basking in the sun with its wings half-open, displaying its brilliant metallic green scales on the upperside that make it so conspicuous. It takes short flights, keeps close to the ground and settles every now and then on small herbs and bushes. The flight is weak and fluttering. It avoids thickets or other shaded places and prefers edges and roads in the forests.

The Common Pierrot keeps a look-out for small flowering herbs, such as *Alternanthera, Justicia, Sida* and *Tridax*. Asteraceous flowers are its favourite. Most of the plants from which

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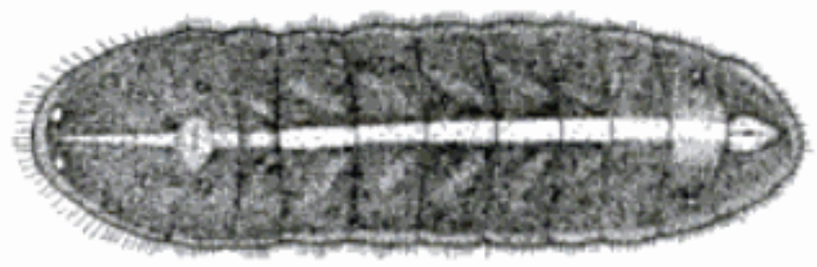
it sucks nectar have tiny, yellow or white flowers bunched together in inflorescences. It also feeds on dead insects and bird-droppings and quenches its thirst on wet soil where many individuals may congregate.

Reproduction The eggs are laid, one at a time, anywhere on young vegetative shoots of 'ber' trees (*Ziziphus*). They are hemispherical and white with a greenish tinge. The surface is finely reticulated with raised thin lines forming cells, their intersections rising into high round-topped cones with a minute depression on the top of each. The tiny caterpillar stays on the underside of the leaves throughout its life. When young, the caterpillar feeds only on the lower tissues of the leaves, leaving the cuticle intact. Therefore, it is easy to find the caterpillar by looking at young leaves and studying the way in which they are eaten.

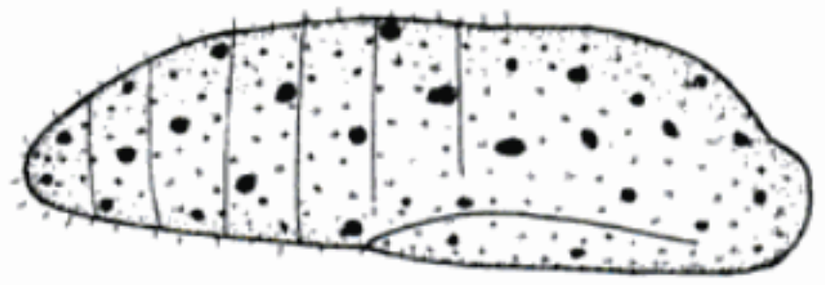
The caterpillar is woodlouse-like in shape with its head hidden under the 2nd segment. It is greenish with a dark or faint line or band on the back, from the 2nd to the last segment and two yellowish lines along its sides. However, the caterpillar looks whitish and "frosted" due to the presence of tiny silvery-white hair, which cover the entire body. It moves slowly.

Pupation usually takes place on the host plant itself, on the underside of a leaf. The pupa is green or brown with a darker line on the back and a yellowish spiracular line. It is marked with black dots.

Though the caterpillar is occasionally attended to by *Prenolepis* or other ants with fleeting interest, it is not completely protected against the Chalcid wasp parasitoids. The adult wasps are usually less than a millimetre in total body length and many grow inside a single Common Pierrot caterpillar. The eggs are attacked by extremely tiny Ichneumon wasps, whose larvae eat the content of the egg from within. Bell has also specifically mentioned fungal infections which kill the caterpillars, but has not mentioned which kinds of fungi infect them. A fungus, *Cordyceps*,



Caterpillar: View from top



Pupa

Length of caterpillar: 11 mm. Length of pupa: 7.5 mm.

grows only on insects and finally kills the host. It is not known whether or not it is *Cordyceps* that infects this butterfly.

Larval Host Plants The caterpillars feed on two species of *Ziziphus*: *Z. rugosa* and *Z. mauritiana* (Rhamnaceae).

49. Zebra Blue

(Plate 23, no. 137)

Scientific Name *Leptotes plinius* Fabricius
(Old: *Syntarucus plinius* Fabricius)

Field Characters Wingspan: 22–30 mm. This species distantly resembles the Pierrots, with which it was earlier classified. Its wings are translucent and the markings on the under surface may be seen through the upperside when the wings are open. The black-and-white 'zebra' pattern on the underside of the wings

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is unique and this at once confirms its identity. The upperside of the wings of the male is pale violet-blue whereas in the female it is brown, with violet-blue restricted to bases of the wings. The female also has an obscure chess-board pattern near the wing-margins.

Small, white with black stripes

Status, Distribution and Habitat The Zebra Blue frequents all open and dry areas, from savannahs and scrub to deciduous forests and secondary evergreen or semi-evergreen forests, or their edges. It is found also in urban gardens and occurs commonly wherever its larval host plants, which are varied, grow. It is active throughout the year. However, it is locally a seasonal species and its annual peak flight periods vary depending upon the flowering season of locally used host plants. Its global distribution extends over the entire Indian subcontinent and parts of southeast Asia.

Habits The larval host plants of this butterfly range in size from bushes to large trees, so it flies in all the vegetation layers, from the undergrowth to the canopy of the deciduous forests. However, it probably finds most of its food close to the ground, and only goes to the canopy if some promising trees are in bloom, or for reproduction. It is quick on the wing, but not very strong and the flight is sustained for a long time. The butterfly flutters close to a twig for some time before finally settling on it. Once settled, however, it is not shy and may allow to approach it closely.

The primary source of nourishment is nectar from small flowers, such as *Alternanthera, Bidens* and *Tridax*. The males are also attracted greatly to wet patches of soil where they accompany other, more regular members, such as the Lineblues and Hedge Blues, at mud-puddling sites. However, they do not form large congregations on their own, as they occur only singly or in pairs.

On rare occasions when the male basks, it keeps its wings half-open. It is pugnacious and chases away trespassing butterflies. In effect, this keeps the area immediately around it clear of other males. The female is relatively inactive, keeps to more shaded places and therefore can be seen less frequently.

It sleeps on the uppersides of the exposed branches of herbs and shrubs. At rest, the fore wings are not drawn between the hind wings.

Reproduction Although this species lays eggs on several plants, *Plumbago* is used most commonly. *Plumbago*, commonly called 'chitrak', is a shrub that is grown in urban gardens as an ornamental plant and also grows on riversides. It has a flowering axis on which number of white or blue flowers are crowded. The calyx of the flowers has sticky glands and they possibly act in ways similar to glands on the insectivorous honey-dew plants (*Drosera* spp.). The honey-dew plants trap the insects in the sticky sugary secretion and digest their tissue. On *Plumbago*, too, various insects, for example wasps and solitary bees, are seen stuck to the secretions of the calyx glands, which eventually die. However, the Zebra Blue female lays its eggs on the buds on the flowering axes. More than one egg may be laid on an axis. The egg is disc-shaped, concavely flattened on top and reticulated. It is glassy greenish-white and shiny.

The caterpillar is woodlouse-shaped and has a coat of fine, almost indistinct hair. The glands and organs of 11th and 12th segment are as characteristic for the family. The colour of the body is green on the ventral surface and sides, red-brown on the back and marked with yellow, sometimes white, diagonal stripes. It stays among calyx of the flowers on a crammed

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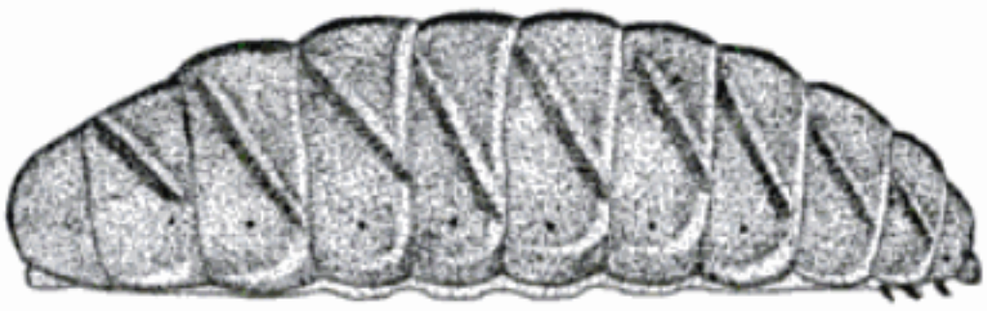
inflorescence. Its striped pattern matches well with its immediate surroundings and it is therefore difficult to locate the caterpillar. On *Plumbago*, ants never attend to it, but on other plants it may attract stray ants. It feeds on the calyx, corolla, other basal portions of the flower and in rare cases on budding leaves.

Pupation takes place often on the same flowering stalk and at the position where the caterpillar rests, or under a neighbouring leaf. The caterpillar may parachute down to the ground with the flower parts when they are shed from the plant. In this case, the caterpillar may pupate on the ground among the leaf-litter. The pupa is similar in shape to that of the Common Pierrot. It is pale brown or pinkish, sprinkled with black spots and dots all over the body. Minute white hair is visible on the surface of the pupa except on the wing-cases.



Length of caterpillar: 10 mm. Length of pupa: 8 mm.

Larval Host Plants Host plants of the Zebra Blue belong to three families:

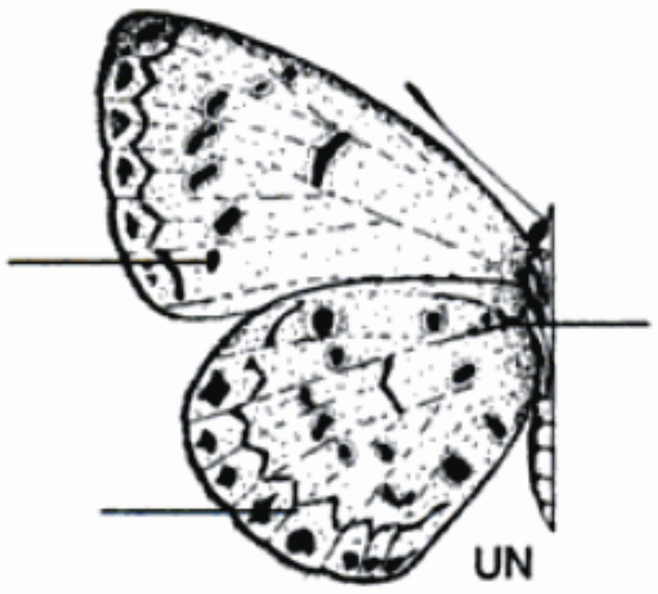
1. Fabaceae: *Albizia lebbek*, a deciduous tree, often an avenue tree, *Sesbania bispinosa*, a small tree popular as livestock fodder and *Indigofera*, a tall herb that yields a dye, all of which are familiar plants to even non-botanists. 2. Plumbaginaceae: *Plumbago zeylanica*, and *Dyerophytum indicum*, a small trailing or hanging herb that grows on rocky outcrops, which was recently reported from Sariska Tiger Reserve, Rajasthan, and 3. Mimosaceae: *Mimosa* spp. Of these, *Plumbago* is utilized most commonly in southern India and *Dyerophytum* in the dry deciduous and scrub jungles of central and northwestern India.

50. Common Hedge Blue

(Plate 23, no. 138)

Scientific Name *Actolepis puspa* Horsfield
(Old: *Lycaenopsis puspa* Horsfield)

Field Characters Wingspan: 28–35 mm. This is a small, very handsome, white butterfly with a pure white face and black eyes. There are black lines and spots on the undersides of its wings and a glossy pale blue brilliant colour on the upper surface. It lacks tails on the hind wings. The female always has a white patch at the centre of the upper surface of the fore wings, but the male may lack it. The pattern of black markings on the underside of its wings is characteristic (see the pointers to the most important spots in the illustrations to distinguish this and similar species).



Small, white, with black spots

Similar Species The White Hedge Blue (*Udara akasa* Horsfield) is very common above 1,300 m at the edges of evergreen forests in the Western Ghats. It lacks the marginal series of black spots that is present in the Common Hedge Blue. The White-disc Hedge Blue (*Celatoxia albidisca* Moore) is larger (wingspan: 32–38 mm) and found at the same altitude as the White Hedge Blue,

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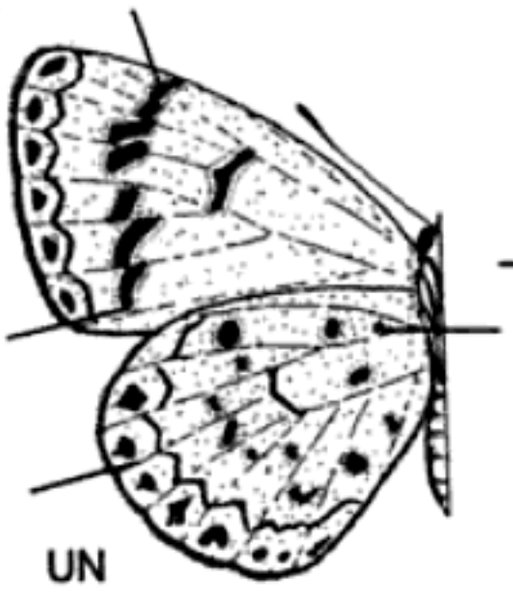
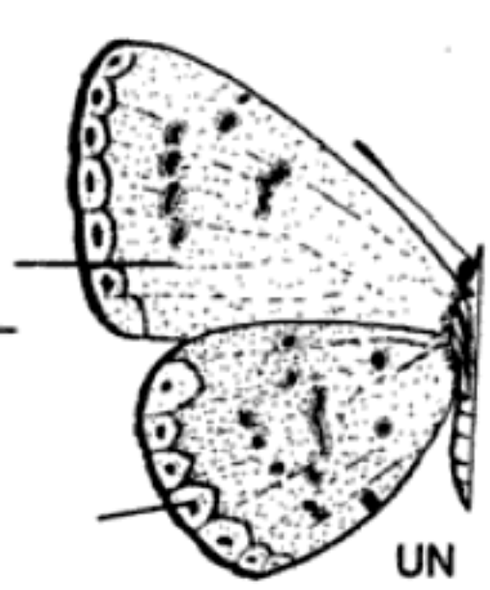
but it may penetrate deeper into the forest. On the upperside of its wings, it has very prominent white areas on all four wings, in both the sexes. The Plain Hedge Blue (*Celestrina lavendularis* Moore) lacks white areas on the uppersides of the wings in both the sexes and the series of black spots on the underside of the fore wings is shorter. The Hampson's Hedge Blue (*Actolepis lilacea* Hampson) is uncommon but very like the Common Hedge Blue. The spots on underside of its fore wing are arranged to form a regular curve, unlike in the Common Hedge Blue.

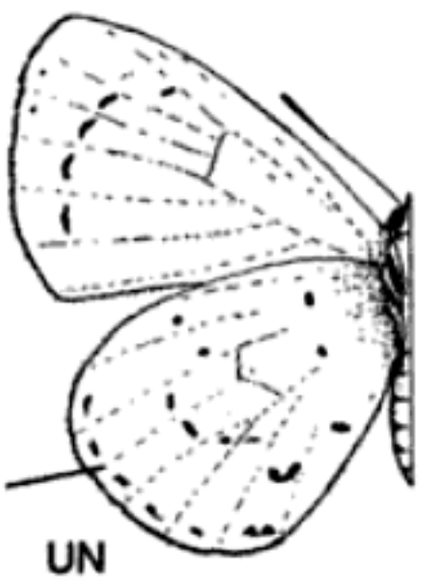
The Malayan (*Magisba malaya* Horsfield) and the Quaker (*Neopithecops zalmora* Butler)



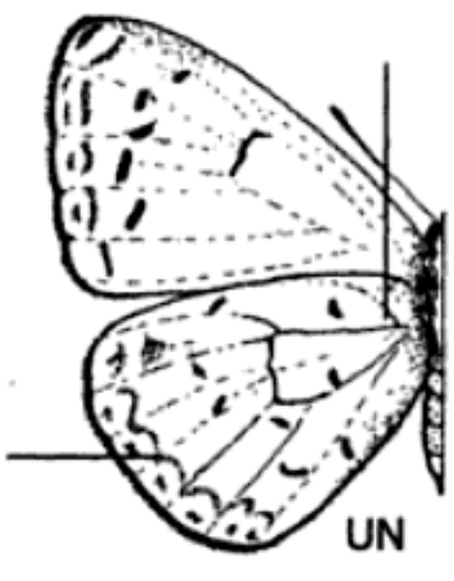
Hampson's Hedge Blue



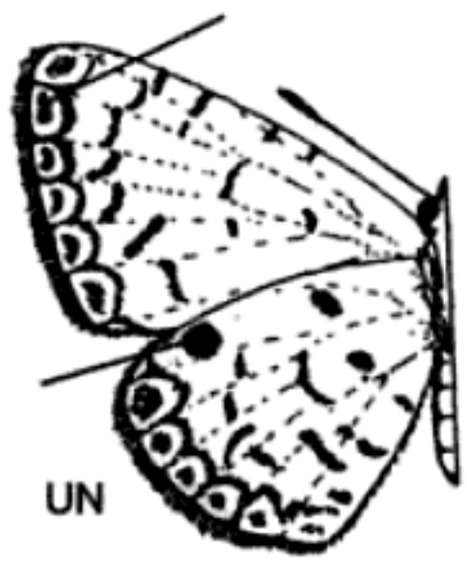
Plain Hedge Blue



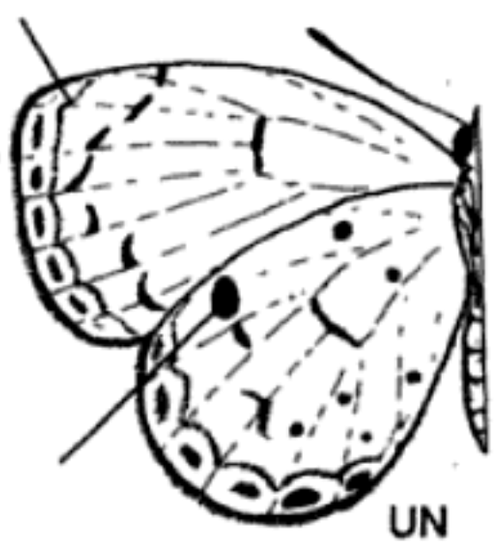
White Hedge Blue



White-disc Hedge Blue



Malayan



Quaker

The Malayan (*Magisba malaya* Horsfield) and the Quaker (*Neopithecops zalmora* Butler) (Plate 24, no. 139) look similar to the Hedge Blues because they are white with black spots and lack tails. However, they can be easily distinguished by their broad, black fore wings with central white areas and the absence of blue scales. On the underside, they have a large black spot near the front margin of the hind wings. The Malayan has a series of four spots at the front margin of the fore wings, which the Quaker lacks. The Malayan also has more pointed fore wings.

Status, Distribution and Habitat The Common Hedge Blue is distributed all over India and in the rest of the Oriental region, in deciduous, semi-evergreen and evergreen forests in the hills. It inhabits moist shaded riparian areas in the deciduous forests, and forest edges and paths in the semi-evergreen and evergreen forests. It flies amidst the undergrowth of bushes, never rising higher to other vegetation layers. Its occurrence is seasonal in the deciduous forests, being restricted to the monsoon and immediate post-monsoon months, and the butterfly is not seen during the rest of the year. However, in the wet evergreen forests it may be found all round the year, spreading everywhere in wet months and being confined to the sides of stream during dry months. It is common and one of the most prominent butterflies in its preferred habitats. However, males are seen more often than the females.

Habits It is a weak flier, but wary when at rest. It flutters with feeble wingbeats, settles often and does not fly far or high. Thus, it keeps close to bushes, and usually around streams, where moisture and shade are always available. However, it prefers patches where intermittent sunlight is present so that it can occasionally bask. For basking it rests on an exposed branch of a bush or a tall herb and spreads its wings partially, then the white discs on the fore wings are very prominent.

Both the males and the females occasionally feed on small flowers, but their staple diet is bird-droppings. On rocks and stones in a stream-bed, this butterfly will be found settled

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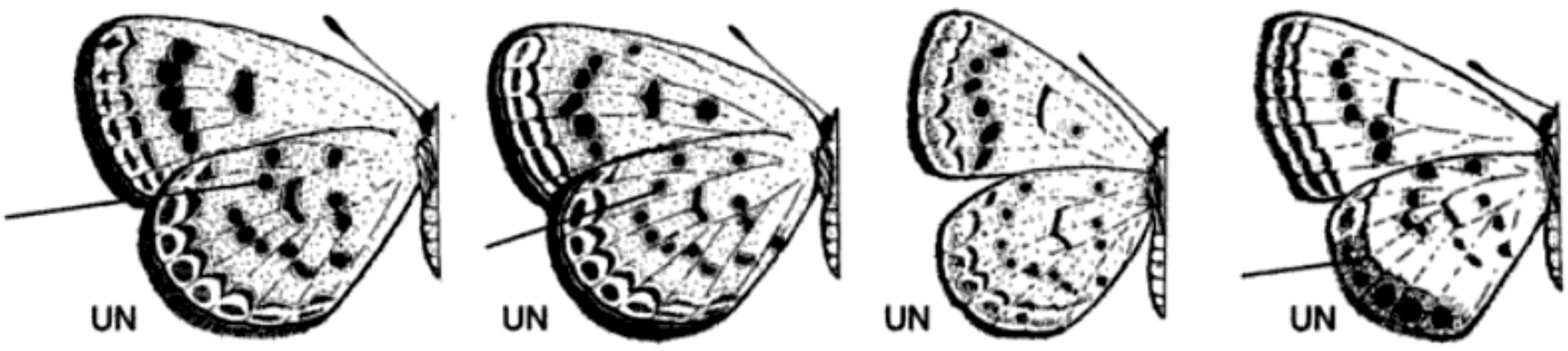
Differences between species of Grass Blues

Species	Wingspan*	Colouration**	Markings
Tiny Grass Blue	16–24 mm Small*	Upperside pale blue, underside white, greyish or light brown**.	Spots narrow and fine.
Lesser Grass Blue (*Zizina otis* Fabricius)	19–26 mm Medium size	Upperside dark blue, underside greyish.	Spots rounded and not very dark.
Pale Grass Blue *(Pseudozizeeria maha* Kollar)	26–30 mm Largest	Upperside pale blue, underside almost white.	Spots rounded and faint.
Dark Grass Blue (*Zizeeria karsandra* Moore)	18–24 mm Medium size	Upperside dark blue, underside usually brown, occasionally grey.	Spots rounded and dark.
Grass Jewel (*Freyeria trochylus* Freyer)	15–22 mm Smallest	Upperside as well as underside brown. Underside spotted with light brown.	Metallic, orange-crowned spots at the margin.

** wingspans taken from Wynter-Blyth (1957).- although the wingspans have wide ranges, the relative sizes given here are* average *of what is usually seen. **The colouration of the upperside refers only to the males. The females are brown.*



Lesser Grass Blue (Plate 24, no. 143) | ***Dark Grass Blue*** (Plate 24, no. 142) | ***Pale Grass Blue*** (Plate 24, no. 141) | ***Grass Jewel*** (Plate 24, no. 144)

savannahs, scrub, deciduous and evergreen forests. Around human habitations it occurs in old, shaded gardens, along nullahs and water reservoirs. In all other habitats, it frequents treams or other moist and shaded patches. However, in the forests it chooses places where sunlight is also available. It is active throughout the year. It is common throughout India, in the plains and the hills and its global distribution extends over all of Africa and south and southeast Asia including smaller islands in the Pacific ocean, such as the New Hebrides.

Habits A unique habit which at once distinguishes this species from all other Grass Blues, and all other 'Blues', is the way in which it moves its wings. As soon as it settles after a flight, it sways all its four wings from side to side, then slows down and finally sits still. Its flight is weak, fluttering and in short bouts; it remains within half a metre from the ground and settles often.

The males occasionally bask with their wings half-open. When active, the butterfly flies in search of small flowering herbs close to the ground. These are usually papilionaceous, asteraceous or acanthaceous herbs. The butterfly has a small proboscis and cannot take nectar from large flowers with long corolla tubes; therefore, its choice of nectar sources is limited. The males also feed from wet soil where they may assemble in a small group.

In cloudy weather or early in the evening it rests on the upper side of the grass blades or herbs, draws the fore wings between the hind wings and keeps its antennae lowered.

Reproduction The host plants bear flowers in inflorescences, in which each flower has leafy bracts. The female lays its eggs singly among the bracts of flower-buds. It bends its

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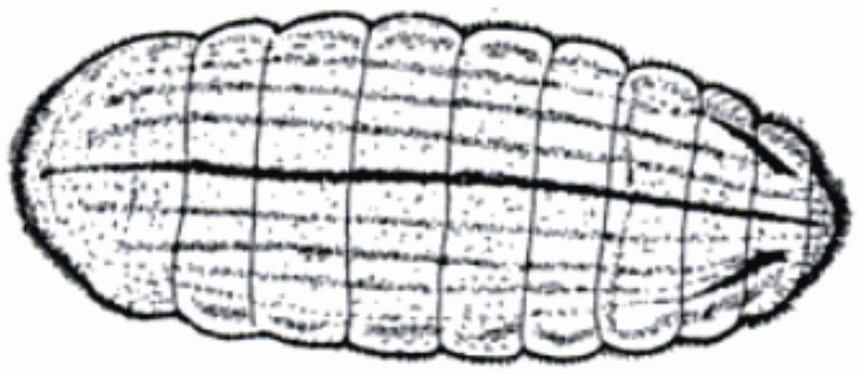
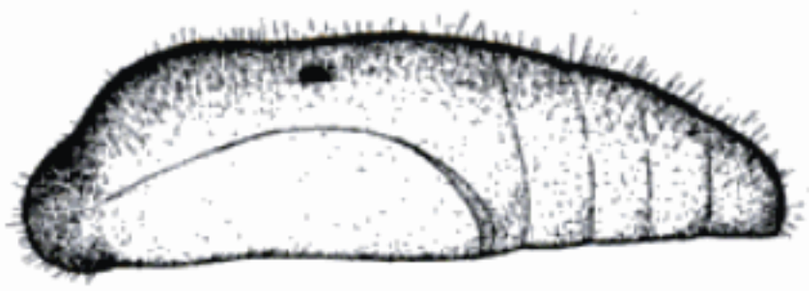
abdomen and reaches deep, into the base of the bract, to lay the egg. The egg is disc-shaped and has fine, smooth, microscopic reticulations on it, which form irregular polygons. It is glassy green with a blue tinge. The caterpillar stays hidden among the bracts and buds and feeds on them. It always sits with its head buried into a bunch of bracts and its body slanting outward and upward, so that one can see only the rear part of the caterpillar's body. The caterpillar is green or brown with dorsal and subdorsal longitudinal lines on the body. It has dark, stiff hair around the 2nd and 14th segments which further obscure it and merge its outline with its surroundings. It thus lives a secretive life and ants do not attend to it.

Pupation takes place close to where the caterpillar fed, as the dense bracts provide good shelter. The pupa is attached to the stem covered under one of the bracts and placed head down. It is supported by a thin body-band. It is long and slender, with gentle thoracic and abdominal humps. It is covered with thin, light, long hair which are especially visible at the extremities of the body. The colour of the body is green or light yellowish-brown, with a darker green or reddish-brown dorsal line on the abdomen.



Caterpillar: view from top



Pupa

Length of caterpillar: 7 mm. Length of pupa: 6 mm.

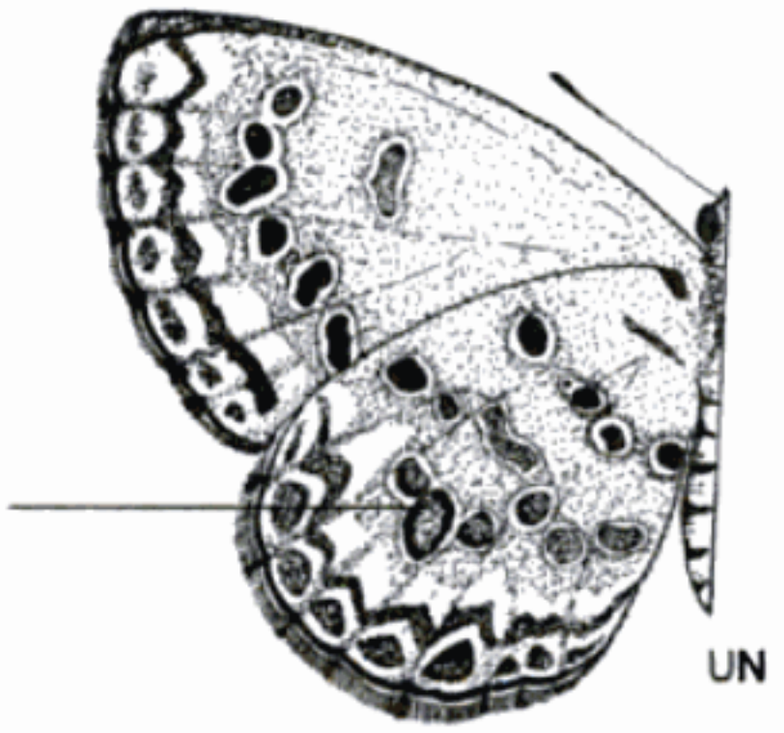
Larval Host Plants The host plants are varied and since this is a wide-ranging butterfly, there are likely to be be many more as yet unreported species. The recorded host plants include: *Hygrophila auriculata, Lantana camara, Nelsonia canescens, Phaulopsis dorsiflora, Strobilanthes* spp. and vetches *Vicia* spp. (Acanthaceae, Fabaceae, Verbenaceae).

52. Lime Blue

(Plate 25, no. 145)

Scientific Name *Chilades laius* Stoll

Field Characters Wingspan: 26–30 mm. It is a light grey, tail-less Blue. The underside has numerous dark spots, but the most prominent of these are two that are joined to each other at a right angle, forming an 'L'. This 'L' distinguishes it from others. In the male, the upperside of the wings is dull purplish-blue, in the female it is brown with blue bases. The dry season form is very distinct because it is more brown than grey. A triangular darker brown patch near the outer margin of the hind



Very small, grey with black spots

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wing is prominent and obscures other spots and markings except the 'L'.

Similar Species It vaguely resembles the Grass Blues, but is larger, and the 'L' is characteristic.

Status, Distribution and Habitat The Lime Blue is most commonly found around human habitations, close to lime, lemon and other *Citrus* plants which are its larval hosts. It is also found in the riparian moist deciduous, semi-evergreen and evergreen forests, but only in open areas. I have seen it active in late monsoon and winter, but it occurs probably throughout the year. It is distributed throughout the Indian subcontinent extending into southeast Asia. In his article Bell, mentioned that around the 1900s, the Lime Blue was "more of a jungle insect". However, now it is much more common around human settlements, probably due to "taming" of this species in orchards. Since the host plants and adult nectar sources are now more abundant in the new, altered environment, this species has proliferated there.

Habits This is a modest flier. It flutters close to shrubs and small trees and settles often. The female may ascend to a height of over 4 m from the ground to reach a suitable spot for laying eggs on the host plant, although this is a laborious effort.

It sometimes basks, especially the male, with its wings half-open. During feeding also it may partially open the wings.

It is fond of fresh bird-droppings, wet soil patches and nectar. Among the nectar flowers, *Sida* and *Malvestrum coromandelens* are it's favourites. The individuals do not usually congregate for mud-puddling.

Reproduction The eggs are laid on the underside of young *Citrus* leaves, one at a time. The egg is disc-shaped and greenish with a blue tinge. The caterpillar stays on the underside of a leaf and is constantly attended to by ferocious red ants which guard it from predators and parasitoids. The caterpillar is green of various shades that match with the leaves and a dorsal darker green line is present. The surface of the body is covered with tiny hair.

The pupa is green with a darker line on the back. It is of the usual 'lycaenid' shape and supported by a body-band. It is made anywhere on the plant or the ground, but usually in a secluded place. Once I found a pupa inside a dead and decayed pupa of the Common Mormon that was destroyed and punctured by Chalcidoid wasps.

There is an unusual report from Tripura of caterpillars of this butterfly feeding on aphids.

Length of caterpillar: 10 mm. Length of pupa: 6 mm.

Larval Host Plants The caterpillars feed on various rutaceous plants: *Atalantia racemosa, Atalantia wightii, Citrus limon, Citrus sinensis* and *Naringi crenulata.*

53. Gram Blue

(Plate 25, no. 146)

Scientific Name *Euchrysops cnejus* Fabricius

Field Characters Wingspan: 25–33 mm. The Gram Blue is a tailed, light grey butterfly marked with thin lines and spots. The pattern of these markings is the key to identification of this species. There is a thin line composed of light brown spots at the outer side of both its wings, in addition to the cell-end bars. The lowermost spot in this series on the hind wing is distant from the line. Near the base of the

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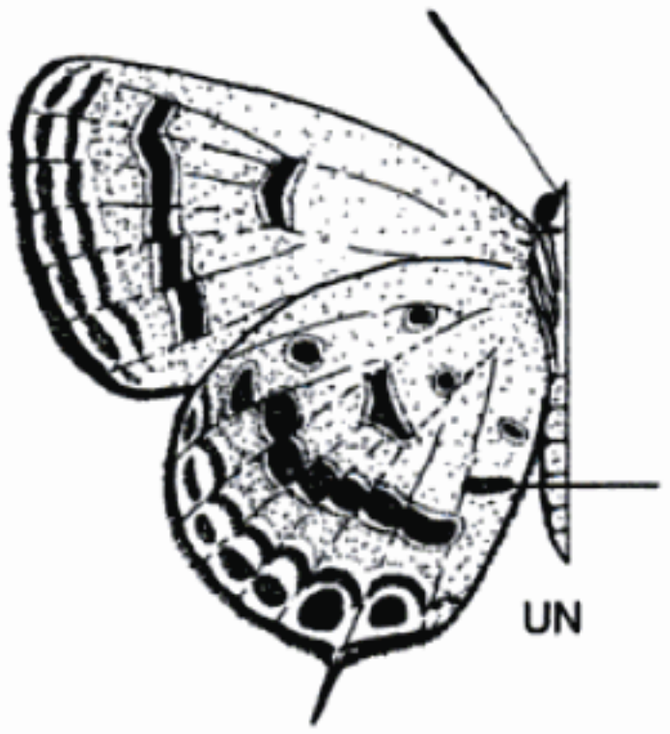
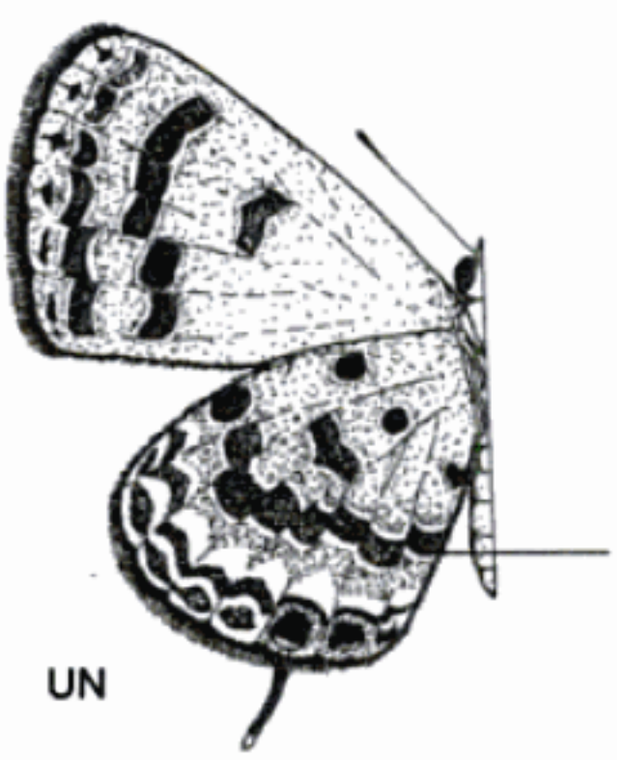


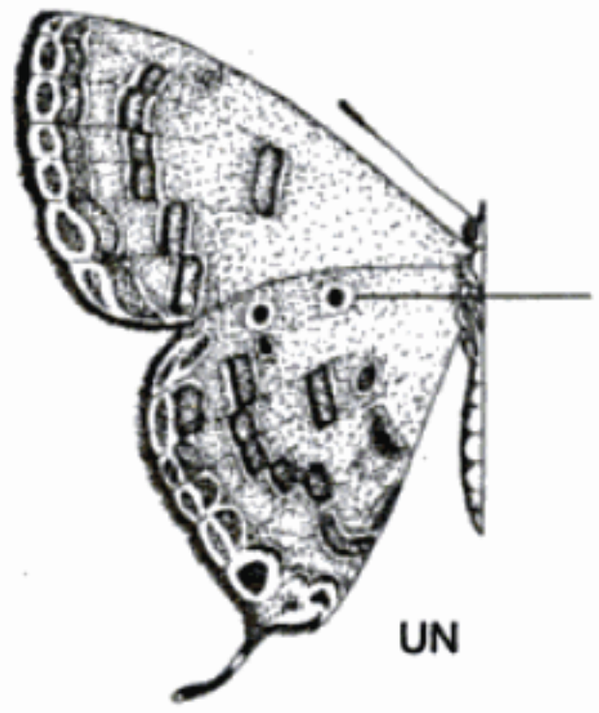
Very small, grey or light brown spotted black, with an orange spot

hind wing are four black dots. The tornus is marked by two black-and-blue-centred reddish-orange spots. In the male, the upper surface of the wings is a pale violet-blue. The female is predominantly brown with scanty blue scaling at the base of its wings.

Similar Species The Plains Cupid (*Chilades pandava* Horsfield) (Plate 25, no. 148) has almost identical markings on the underside, but the lowermost spot of the series on the hind wing in this species is juxtaposed to the line formed by the other spots. The Indian Cupid (*Everes lacturnus* Godart) (Plate 25, no. 147) is almost white on the underside and its tornus has two very bright orange spots. The Forget-me-not (*Catochrysops strabo* Fabricius) has narrower wings and only two black spots near the base of each hind wing. It flies faster. All these



Plains Cupid



Forget-me-not

species are of roughly the same size and share most of their distributional ranges. They also share their habitats, except that the last two species are found more in the scrub and dry deciduous forests and avoid highly man-modified landscapes such as cultivated fields.

Status, Distribution and Habitat It is a very common butterfly in open, drier areas where its larval host plants grow. Since it feeds on cultivated as well as wild species of papilionaceous plants (peas, beans, etc.), it is abundant around human settlements and agricultural fields. It is more common during the late monsoon and post-monsoon period, but may also be found during the summer. The seasonal population dynamics depend on the availability of larval host plants, which may be severely affected by annual fires. The species' global distribution extends over all of south and southeast Asia, extending into the Australian region and even to far-flung islands in the Pacific Ocean.

Habits The Gram Blue is fond of sunshine and therefore avoids any kind of shade. As a rule, it flies within half a metre from the ground. However, in search of host plants and occasionally nectar, it may go to the tree-tops. Although small in size and slightly weak while flying, it is a persistent flier and may flutter for a long time. This does not necessarily take the butterfly far, as its flight is quite directionless.

The main source of nourishment for this butterfly is nectar from tiny, inflorescenced

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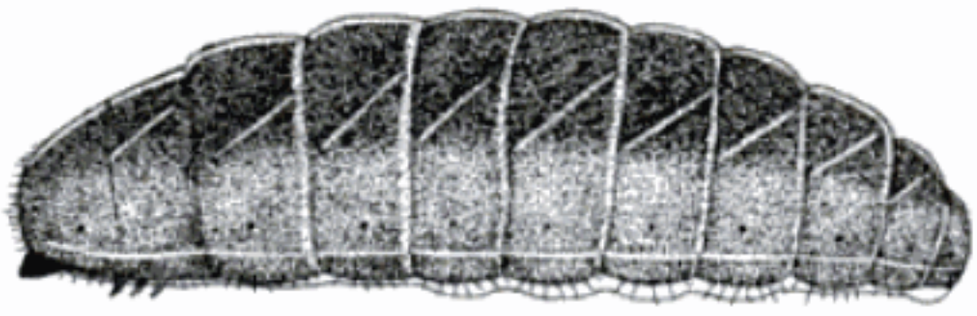
flowers of small herbs. *Tridax*, *Alternanthera* and fabaceous prostrate herbs are some favourites. Damp soil patches also attract the males and a few of them may assemble at a mud-puddling site.

Reproduction Mating takes place usually during the noon and afternoon. The female lays its eggs singly in the axils and on the stalks of flowers. Each egg is light green, disc-shaped and reticulated on the surface. The caterpillar is woodlouse-shaped, green in colour, with darker markings on the back. The second colour form is dark red-brown, with yellow diagonal lines on the back. It feeds on flowers and tender pods. It is attended to by ants and lives on the undersides of flowers or under the calyx when young, later it bores inside the pods and eats the developing seeds. It comes out of a pod only for a changeover to another pod.



Length of caterpillar: 12 mm. Length of pupa: 8 mm.

The pupa is green or red-brown in colour. It is situated inside a pod, under a leaf, on the ground, etc. where it is well-concealed and therefore difficult to locate. It is similar in shape to that of the Common Cerulean.

Larval Host Plants The known host plants are various legumes. They are recorded from different parts of the country. Some of them are utilized commonly, others are used only locally and rarely. So far, the following species have been recorded: *Acacia* spp., *Butea monosperma*, *Paracalyx scariosa*, *Ougeinia oojeinensis*, *Pisum sativum*, *Vigna cylindrica* and *Vigna trilobata* (Fabaceae and Mimosaceae). These plants range from small prostrate herbs to medium-sized trees. The wild and cultivated species or varieties of grams and beans are used commonly around the human habitations.

Economic significance As the Gram Blue feeds on floral parts of some of the fabaceous crop plants (mainly grams, as name suggests), it is considered a minor pest on these crop plants. If the butterfly population is unchecked, it can cause considerable crop damage because the caterpillars feed directly on marketable parts of the plants.

54. Pea Blue

(Plate 25, no. 149)

Scientific Name *Lampides boeticus* Linnaeus

Field Characters Wingspan: 24–36 mm. The species can readily be identified by light to dark reddish lines on the white underside of its wings. There is a distinct white band within the outer margin of the hind wing where these lines are absent. On the upperside, the male is violet-blue and the female is brown with blue scaling at the bases of its wings. The hind wing has a slightly long, white-tipped

Small, white with reddish lines

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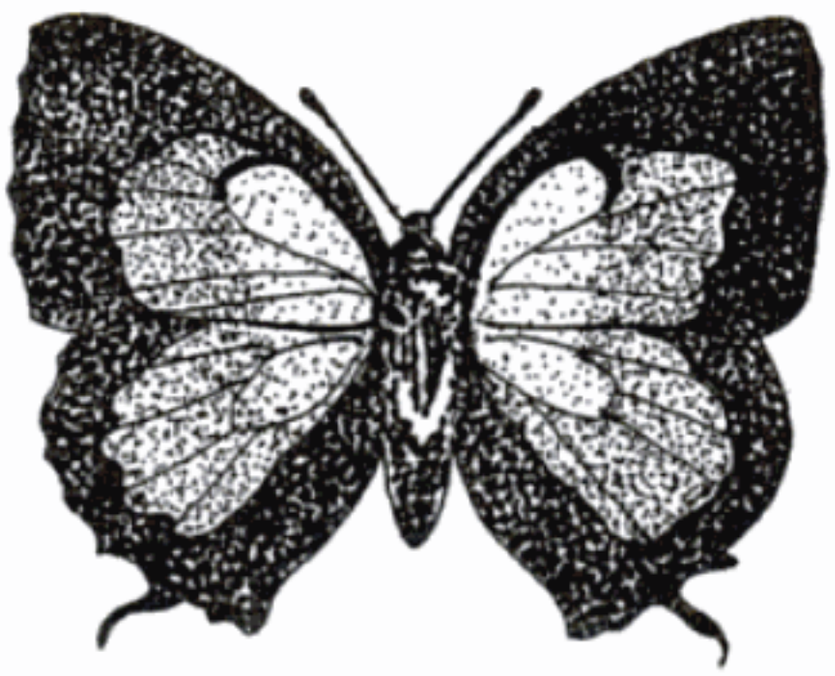
58. Large Oakblue

(Plate 26, no. 155)

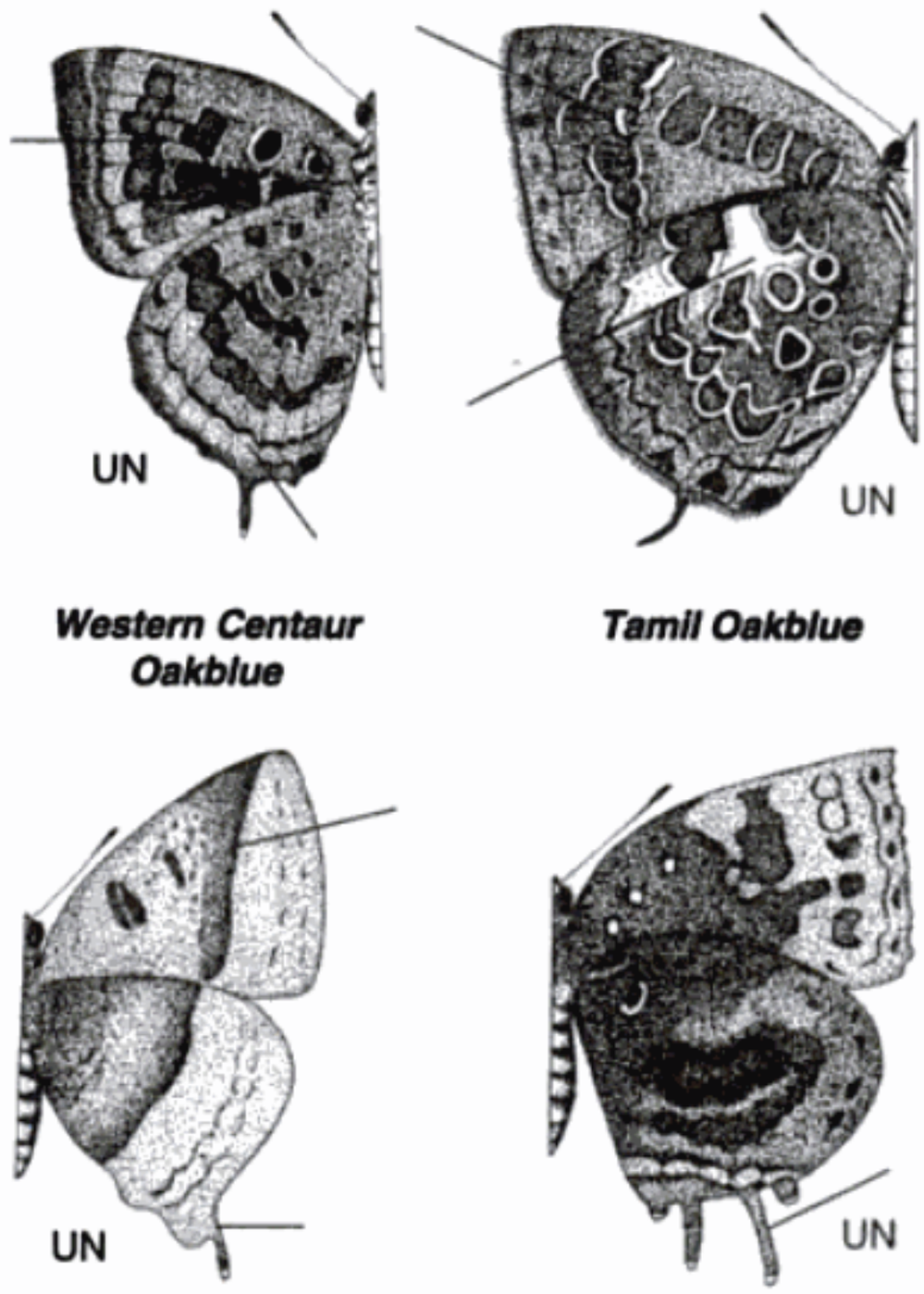
Scientific Name *Arhopala amantes* Hewitson (Old: *Amblypodia amantes* Hewitson)

Field Characters Wingspan: 45–57 mm. The Large Oakblue is the second largest Blue in peninsular India and is unmistakable due to its blazing colours. The upperside of its wings is a brilliant deep blue. The male has a thin black border while the female has a broader one. The underside is pale brown with dark brown spots that are outlined in white. The tornus of the hind wing has prominent metallic green scales. The discal band on the underside of the fore wing is dislocated at the 4th vein.



Medium-sized, brilliant blue (upper side) and brown (underside) with darker spots

Similar Species A number of species are similar to the Large Oakblue on the upperside of the wings and they are a shade of deep blue or purple-blue, with thinner or broader borders. The Western Centaur Oakblue (*Arhopala pseudocentaurus* Doubleday; wingspan: 53–62 mm) is the largest Blue in peninsular India. It either lacks the green scaling at the hind wing tornus or the scaling is obscure. The discal band on the underside of the fore wing is not dislocated at the 4th vein. In the Tamil Oakblue (*Arhopala*



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bazaloides Hewitson), the discal band on the underside of the fore wing is dislocated at the 4th vein, but this species is smaller (wingspan: 44–47 mm). It is chocolate-brown overlaid with white scales near the margins of the wings and the spots on the fore wing are outlined in white. The Kanara Oakblue (*Arhopala alea* Hewitson; wingspan: 44–45 mm) is locally common in and around the Kannada districts of Karnataka. This butterfly is purple-brown below, with a purple glaze. Its discal band is narrow and unbroken at the 4th vein. The tornal green scales are obscure.

The Leaf Blue (*Amblypodia anita* Hewitson; wingspan: 45–52 mm) is variable in colour and markings, but usually has a dark line running from the tornus of the hind wing to the apex of the fore wing. At the tornus, it has a broad lobe with a tail. The Many-tailed Oakblue (*Thaduka multicaudata* Moore; wingspan: 40–48 mm) (Plate 26, no. 156) is chocolate-brown with four tails and metallic green scales at the tornus. The Silverstreak Blue (*Iraota timoleon* Stoll; wingspan: 40–48 mm) (Plate 27, no. 157) is also chocolate brown, but its wings are richly marked with glistening silver spots and lines. These three species are locally common. They can be seen frequently, particularly along water courses in the dense semi-evergreen and evergreen forests of the Western Ghats. They are active throughout the year except during heavy rains.

Status, Distribution and Habitat This is an uncommon species, but commoner than its kin and more widespread. It is especially more common in the coastal and surrounding lowlands, hot, humid, deciduous and semi-evergreen forests. It prefers secondary forests and associated dense undergrowth. It is most active during the post-monsoon season and the summer, but more visible during the dry season when it frequently visits water-holes. It is found in peninsular India, the foothills of the Himalayas and northeastern India. Its global distribution also ranges over southeast Asia.

Habits This butterfly is more likely to be encountered at water-holes, for it occurs during the unbearably hot and humid summer months in forests. However, unlike many other butterflies that regularly visit wet soil, it is found usually alone, rarely in twos or threes. It is restless during its visits to the wet soil, therefore it walks around, investigates new spots, takes a few sips from as many moist patches as it feels like and then flies away. It is wary while mud-puddling and flies away on any conspicuous movement around it. Flowers hold no attraction for it but sap oozing from wounded tree-trunks is agreeable and the butterfly may occasionally be found at it.

When not at the wet soil, it spends most of its time resting on the foliage of small trees and tall bushes. It usually perches amidst the dense foliage and often on the undersides of leaves. Once settled, it is reluctant to take off and, if disturbed, at first only walks a few steps. Then, if the disturbance persists, it suddenly shoots into the air like a bullet. Its course in the air is winding and this makes it a difficult butterfly to follow. However, it often returns to the same spot or nearby. It remains active until late in the evening.

The male is quarrelsome by nature and engages in a fierce chase if another member of its species enters the vicinity. It rarely basks, with its wings partially spread, but the female never basks.

Reproduction The female lays eggs singly on the upper surface of the leaves or petioles. The egg is hemispherical and covered with pentagonal cells. It is green with darker dots on it. The little caterpillar that hatches out of the egg is guarded by the red tree ants (*Oecophylla smaragdina*), which are very fierce. These are very common in the lowland forests of the Western and the Eastern Ghats and the Satpuras. They are always around the caterpillar to collect the honey-dew that the caterpillar secretes from its abdominal glands and organs. In return, they guard the caterpillar against parasitoid and predator attacks. The story does not end when the caterpillar pupates, after which it ceases secretion. The ants guard the pupa until the butterfly emerges from it.

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The tiny caterpillar initially lives in the open and always on the underside of a leaf. As it grows, it makes itself a house by folding over a leaf portion. From then on it stays in this cell and even pupates in it. The ants keep crawling all around and over it, constantly fondling the caterpillar's glands with their antennae. The caterpillar is much flattened, its 2nd segment is shiny and its front edge covered with long reddish hair. The spiracles are red-brown and surrounded by red hair. The colour of the body is grass-green with a dorsal brown band which is flanked by a double yellow line. A lateral yellow line runs from end-to-end of the body.

Caterpillar

Pupa

Length of caterpillar: 36 mm. Length of pupa: 18 mm.

The pupa has a prominently humped thorax. It is light brown, blotched with darker brown. The gland and organs of the 11th and 12th segments leave distinct scars on the pupa. The surface of the pupa is shiny, slightly rough and covered with small white tubercles and hair.

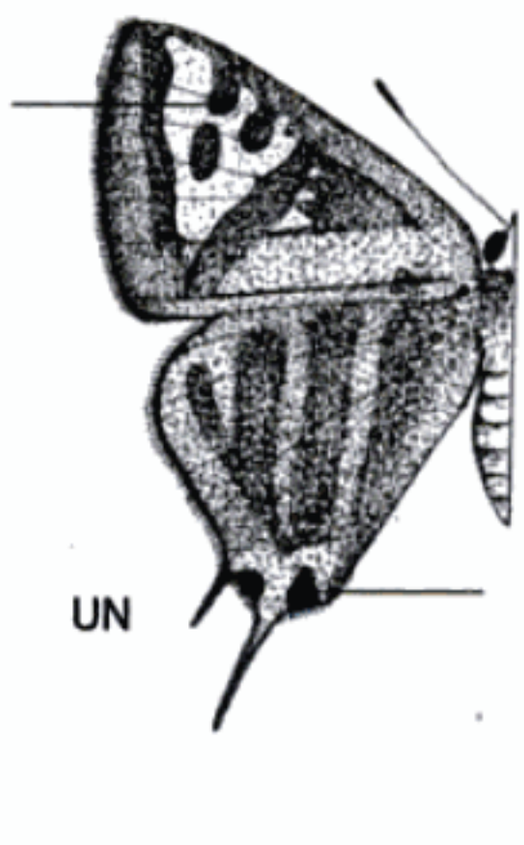
Larval Host Plants The host plants are huge trees in moist deciduous and semi-evergreen forests. These include various species of *Terminalia (T. alata, T. catappa* and *T. paniculata*; Combretaceae), *Lagerstroemia* (*L. microcarpa* and *L. reginae*; Lythraceae) and *Xylia xylocarpa* (Mimosaceae). *Terminalia* and *Lagerstroemia* are more commonly utilized.

59. Common Silverline

(Plate 27, no. 158)

Scientific Name *Spindasis vulcanus* Fabricius

Field Characters Wingspan: 26–34 mm. The Common Silverline is a vividly marked butterfly with an unmistakable form. Its wings are narrow and pointed and the hind wing has a large lobe with two long tails, the lower one being longer. The massive, powerful thorax gives it a graceful appearance. The underside of the wings is a light yellow with brilliant red bands. These bands are surrounded by thin black lines on either side and also have central golden lines. The band that starts from the base of the hind wing does not touch the central, longer band. The tornus



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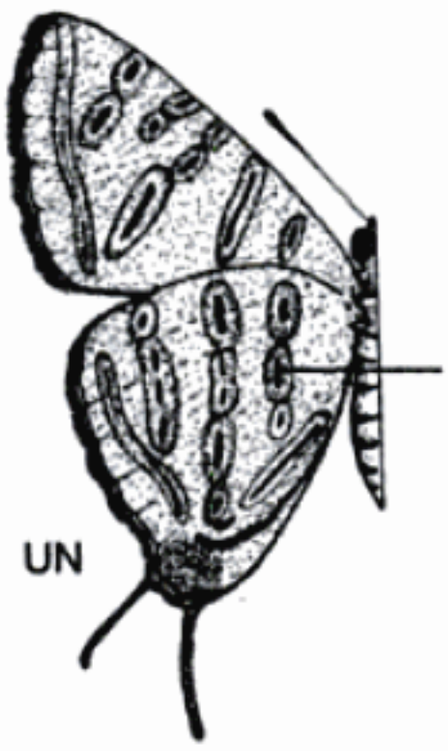
Small yellow with golden silver lines outlined red and black

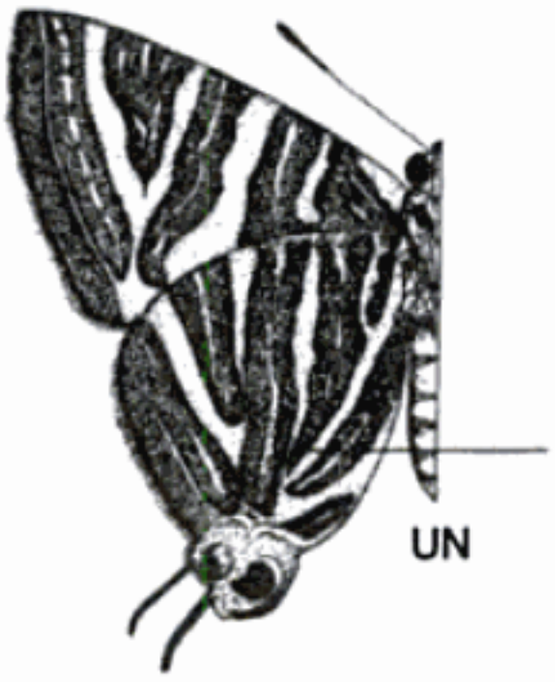
of the hind wing is orange and gives rise to the tails. The upperside of the wings is dark, with orange bands. In the males, the upperside is suffused with blue.

Similar Species There are 8 species of Silverlines in peninsular India. Of these, the Common Silverline is the most widespread and common. Apart from the Long-banded Silverline (*S. lohita* Horsfield), which looks very similar to the Common Silverline, all the other species are less bright on the underside and usually uncommon. Many of them are also geographically restricted. In the Long-banded Silverline, the band that starts from base of the hind wing always touches the central long band. The Shot Silverline (*S. ictis* Hewitson) (Plate 27, no. 159) and the Scarce Shot Silverline (*S. elima* Moore) occur in drier areas. Each of these has its first band on the underside of the hind wing broken into three spots. However, like the Common Silverline, the Scarce Shot Silverline is vividly coloured, whereas the Shot Silverline is a dull yellowish-brown with only traces of golden and yellow lines.



Shot Silverline

Scarce Shot Silverline



Longbanded Silverline

Status, Distribution and Habitat This butterfly is omnipresent ranging from sea level to the crest-lines of mountain ranges and from scrub to secondary evergreen forests, but it occurs primarily in open areas. It prefers natural vegetation to the tamed landscapes of urban areas, such as gardens or plantations. It is most common in deciduous vegetation and in the openings and edges of semi-evergreen forests, and is active in all seasons. It is restricted to the Indian subcontinent.

Habits The Common Silverline has a powerful flight. However, it is reluctant to take off, a habit which it shares with the Large Oakblue and therefore waits until the observer comes very close. Once in the air, it is almost impossible to follow its course owing to the extremely swift flight and sinuous flight-path. Nonetheless, it usually returns to a nearby perch. It sits on medium-sized bushes or near the ground, at a height of between a few centimetres to about 2 m from the ground. It chases away other butterflies from this place.

It visits flowers and flies in search of them, any where from the ground to the highest canopy. Since it inhabits open, secondary forests, its nectar source is often weedy species, such as *Lantana, Chromolaena* and *Mikania*. It also feeds on bird-droppings. While on a good nectar source or otherwise, the butterfly is found in loose groups.

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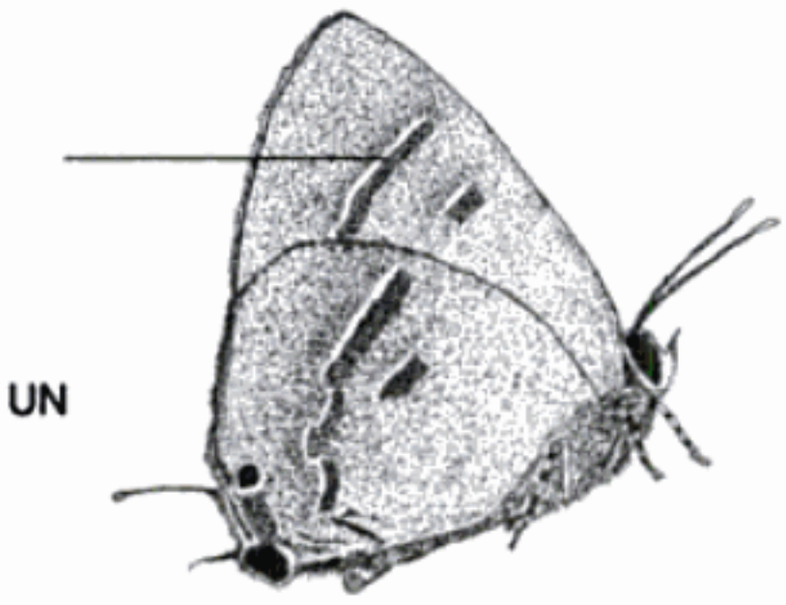
61. Slate Flash

(Plate 27, no. 161)

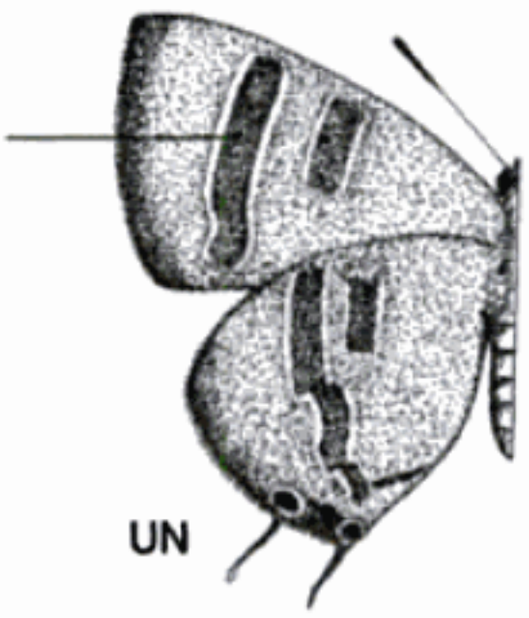
Scientific Name *Rapala manea* Hewitson
(Old: *Rapala schistacea* Moore)

Field Characters Wingspan: 30–33 mm. The Slate Flash is a strong flier and therefore has a big thorax. Its wings are large and the body is comparatively small. The underside is brown and marked with a thin, slightly curved, darker band that has a whitish margin at its outer edge. There is a short bar near the cell-end on each wing. The upper surface of the wings, in the male, is dark slaty-blue with a deeper blue glistening suffusion. The female is shiny purplish-blue, but paler.

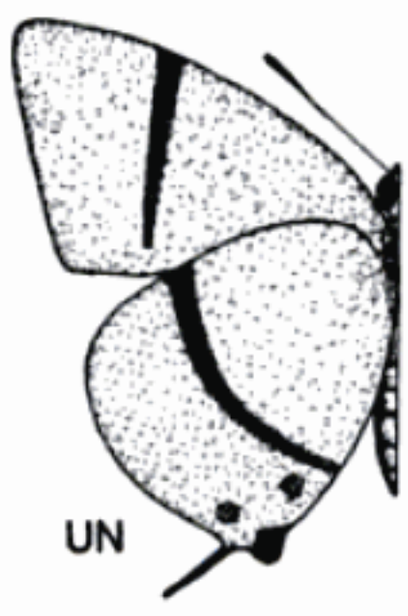


Small, brown with a darker band and a black tail-lobe

Similar Species The Indigo Flash (*Rapala varuna* Moore) (Plate 28, no. 163) is widespread and not very rare. In this species, the darker band near the wing-margins has white borders on both the sides. The Malabar Flash (*Rapala lankana* Moore) is extremely rare and localized in the southern Western Ghats. It is rusty-brown on the underside. The Indian Red Flash (*Rapala jarbus* Fabricius) (Plate 27, no. 162) looks similar on the underside, but is bright red on the upper surface. It is common all over peninsular India.



Indigo Flash



Malabar Flash

Status, Distribution and Habitat This species is commonest in riparian, moist, deciduous, semi-evergreen and evergreen forests, especially in openings and along the streams, but also in the dry deciduous forests and secondary scrub derived from forests. It is most active during the monsoon and post-monsoon period, but in the evergreen forests it may be found in any season. It is distributed in the Indian subcontinent and Myanmar.

Habits The Slate Flash flies at any height from the ground. It could sit next to the ground on small herbs or whirl around canopies of the tallest evergreen trees. However, it usually chooses medium-sized trees or tall shrubs on which it perches on outstretched branches. It is not shy and therefore tolerant of minor disturbance around its perch, but it is swift when it takes off. It flies smoothly and straight. Due to its speed and inconspicuous colours, it is difficult for the eye to follow.

It is fond of flowers and prefers shrubs as its nectar source. On a good patch it may spend a long time flitting from flower to flower. Sometimes the males visit wet soil patches for mud-puddling.

It basks with its wings half-spread.

Reproduction The choice of host plants seems heavily dependent on the presence of ants, which guard and take care of the caterpillar. When a flowering plant with ants is found, the female lays disc-shaped eggs singly among flowers. The caterpillar is constantly attended to by *Cremastogaster* tree ants. The caterpillar feeds on the floral parts and lives in the open without making a cell. It is sluggish in its movements.

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The caterpillar is similar in shape to that of the Royal. There are dorsal and sub-dorsal small tubercles on the 4th to 10th segments. The entire surface of the caterpillar is covered with fine, short, dark hairs. However, the extremities are set with longer, whitish hairs which are readily visible. The gland on the 11th segment is very large but the organs of 12th segment are normal in size and shape. The caterpillar is green with a yellowish spiracular line that runs from end-to-end of the body. Each segment has a diagonal white line on the side.

Before pupation, the caterpillar wanders a bit in search of a suitable place to pupate. It weaves a pad of silk on which to rest during the pupal stage and a body-band to support the pupa. After this, it turns rosy-pink and remains still for the moulting to take place. The pupa has a hump on the thorax and abdomen. It is pink-brown, smudged with dark brown over the surface and has a black or dark brown abdominal line.

Length of caterpillar: 19 mm. Length of pupa: 12 mm.

Larval Host Plants Host plants of this species belong to six families, illustrating the wide range of the caterpillars' diet. The most important criterion for deciding host plants seems to be the presence of ants on the plant. The host plants recorded are as follows: *Sorbaria sorbifolia* (Rosaceae), *Antidesma acidum, A. ghaesembilla* (Euphorbiaceae), *Ziziphus* sp. (Rhamnaceae), *Quisqualis indica* (Combretaceae), *Camelia sinensis* (Theaceae) and *Acacia megaladena, A. pennata, A. torta* (Mimosaceae). Only one or two species are recorded from each family, but there are likely to be many more.

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5.5 Family Hesperiidae

Skippers

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are parallel and very close to the substratum and hold the fore wings at an angle to the hind wings. This exposes their fore wings as well as hind wings while they bask.

Members of this family are not migratory. Some exceptions, such as the Brown Awl and the Common Banded Awl, occasionally have to travel short distances. However, these are comparatively insignificant in terms of number of individuals moving in or out of an area. These movements, in any case, are not regular.

The adults feed on a variety of resources. Many visit flowers. Their long proboscis is a great asset in feeding on nectar from small as well as large flowers. Some species come to wet soil, others feed on birds' droppings.

The eggs are laid singly at the tips of the leaves. They are dome-shaped, large, shiny and ridged. The caterpillars spend all their lives in cells made of leaves or parts of leaves, which are prepared by the caterpillars for that purpose. The pupae are smooth and shiny, enclosed in the cells and many are enveloped in a thin layer of smooth white powder.

Peninsular Indian species are arranged in three subfamilies, namely, Coeliadinae, Pyrginae and Hesperiinae. The members of these subfamilies and their characteristics are as follows:

1. **Subfamily Coeliadinae** The Awls, Awlets and Awlkings (9 species in peninsular India): These are relatively large butterflies that inhabit dense forests, mostly evergreen forests. They have long, narrow fore wings and rounded hind wings. The hind wing has a prominent, deep fold at the inner margin and is produced at the tornus. The Awls have a big, black or chocolate-brown spot hidden in this wing fold. This spot is very prominent in museum specimens whose wings are completely spread, or in newly-emerged specimens with still wet wings, in which the fold is not yet developed. In nature, this spot is never seen.

   The two sexes look similar, but the males have streaks of specialized scent scales and brands on the fore wings.

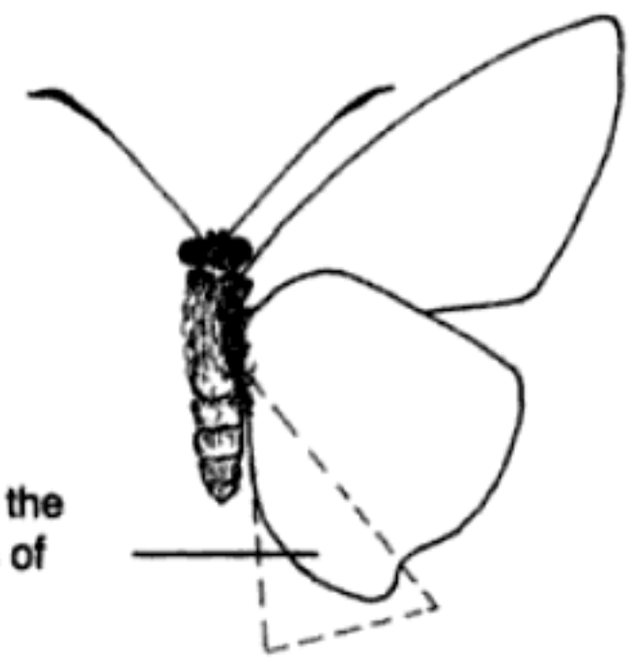
   The labial palpi are broad and fluffy and the third segment of each palp is long, thin and protrudes in front of the eyes. The eyes are large, usually dark brown or black. The head is unusually large and broad compared to the body and may be broader than the shoulders. This is probably an adaptation to accommodate the large eyes, which are suited to crepuscular activity.

   The caterpillars feed on dicotyledons. They are smooth and cylindrical, colourful and vividly marked, often gaudy. The pupae are thick and short.

2. **Subfamily Pyrginae** The Flats and Angles (approximately 20 species in peninsular India): These species are characterized by their sitting posture and the shape of their wings, which have given them their common generic names. Unlike all other Skippers and other butterflies, they always sit with their wings spread flat, whether they are active or not. This is a characteristic of moths, found only in this group of butterflies. When active, the Golden Angle sometimes holds its wings raised at a 45° angle, but never closes them completely. All the species rest or sleep on the undersides of leaves.

   The males of many species from this group have erectile tufts of hairy scales on the legs or fore wings and hind wings.

   These are primarily forest insects. A few species, for example the Small Flats, may be found in open areas such as grasslands and rocky outcrops in the hills,



The fold in the hind wings of Skippers

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but a majority are found in deciduous, semi-evergreen and evergreen forests. They may be found in the dense shade of the forest, but prefer sunlit areas to shady ones. Therefore, they are more common along forest streams and paths.

The Chestnut Angle visits wet soil patches, the Golden Angle may visit wet mud walls and the Spotted Flats feed on bird-droppings and nectar.

The caterpillars feed on dicotyledons. They are usually shades of green and not very marked. Their heads are very large compared to the second segment and may be hairy. The pupae are stout but not very short, sometimes with a long proboscis that extends beyond the end of the wing-cases.

3. **Subfamily Hesperiinae** The Demons, Bobs, Aces, Darts, Redeyes, Swifts, etc. (close to 60 species in peninsular India): This subfamily includes all Skippers not included in the earlier two subfamilies. It is the most widely-distributed group, its members being represented all over the world. They are also amongst the most common Skippers. However, with the exception of some Redeyes, they all are small inconspicuous butterflies. They inhabit open areas, which may be dominated by grass. The Demons and Redeyes, however, are predominantly forest species.

Many feed on nectar, but bird-droppings are also a favourite source. However, mammalian droppings are ignored. Some species visit wet soil, but they never form mud-puddling assemblages of even a few individuals or join those of Whites and Yellows or Swallowtails. The individuals are found alone at wet soil patches.

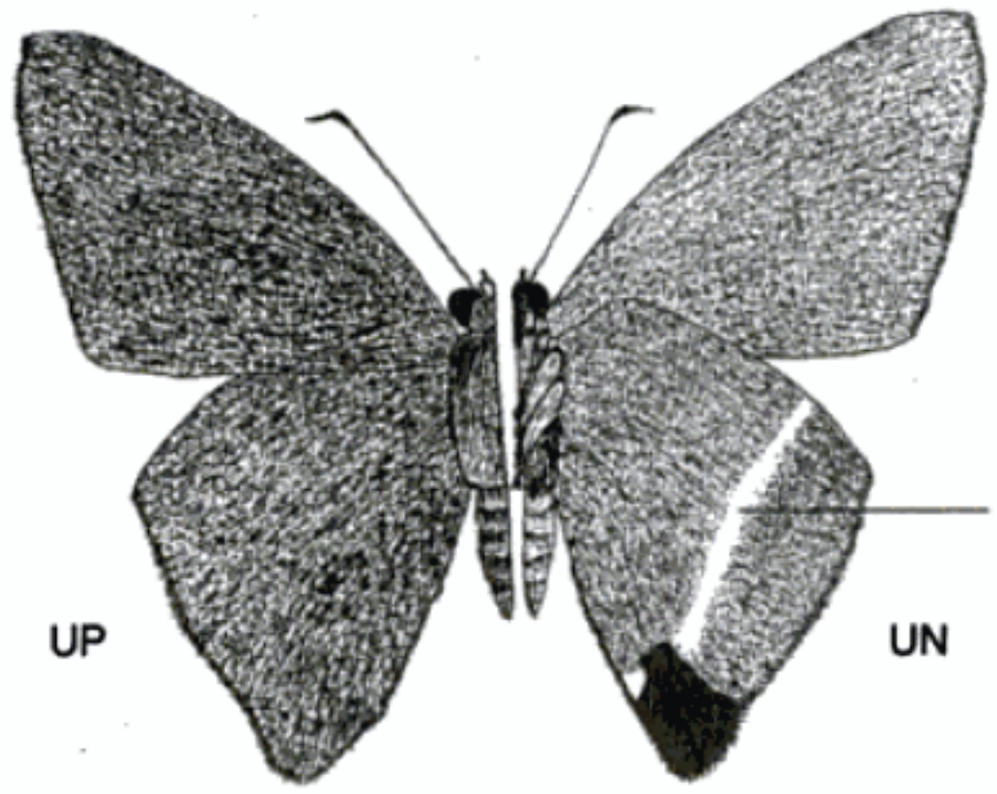
The caterpillars feed mostly on the monocotyledons, that is, grasses, bamboos, palms, relatives of turmeric, etc. They are smooth and green with black or dark brown heads, which may be hairy. The heads are large and the second segment small, forming a distinct "neck". The pupae are long and tapering.

62. Common Banded Awl

(Plate 28, no. 164)

Scientific Name *Hasora chromus* Cramer
(Old: *Hasora alexis* Fabricius)

Field Characters Wingspan: 45–50 mm. This is a dark brown butterfly with a big, strong thorax, pointed fore wings and a white band at the centre of the underside of the hind wings. The upperside of the wings in fresh specimens is velvety brown; the males are unmarked, the females have some small semi-transparent spots. The underside of the wings, especially in very fresh specimens, is glossed a with faint blue-purple. The pure white band on the hind wing fades at its outer margin. A large black spot is present at the



***Common Banded Awl** Small to medium-sized brown with a white band*

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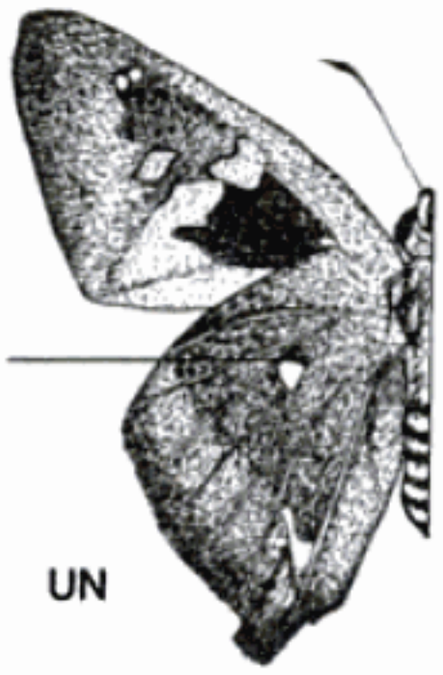
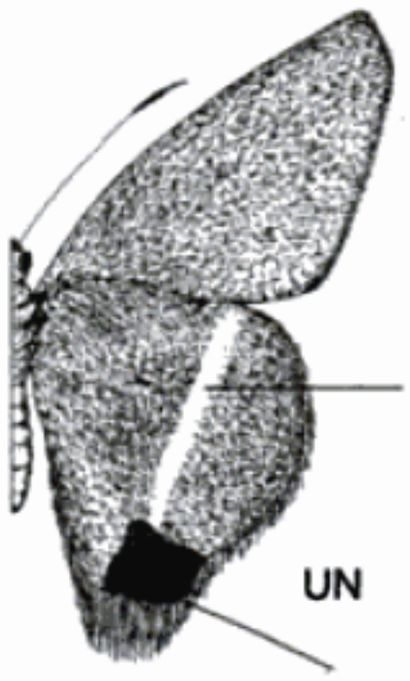
lower corner of the underside of the hind wing, but is visible only for a few minutes after the butterfly emerges from a pupa, then a fold in the wing develops in which the spot is concealed. This spot is visible also in museum specimens, which are completely spread out, but never in the field.

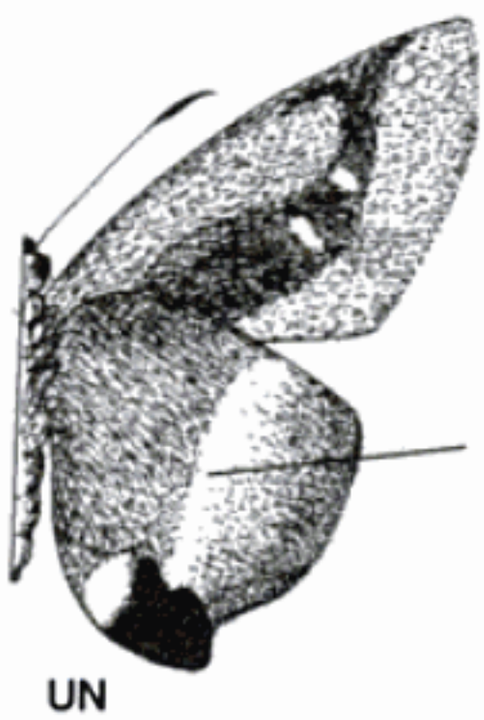
Similar Species Three other species of Awls (*Hasora* sp.) look similar, except for differences in the white band on the underside of their hind wings. The Plain Banded Awl (*Hasora vitta* Butler) has a broader band that diffuses outwards and its wings are more prominently glossed. The White Banded Awl (*Hasora taminatus* Hübner) (Plate 28, no. 165) also has a broader band, which is sharply defined. The Common Awl (*Hasora badra* Moore) lacks the white band of other Awls. Instead, it has a white spot and is slightly rust-coloured on the underside. The Orange-tail Awl (*Bibasis sena* Moore) also looks very similar with its dark brown wings and a white band on the underside of the hind wings. However, it has a characteristic bright orange fringe on the hind wings and on the tip of the abdomen, which may be visible from some distance. The Brown Awl is somewhat similar. It is paler brown, lacks the white band and is characterized by much narrower wings. Except the last species, the others are found thick, usually evergreen, forests and they avoid strong light.



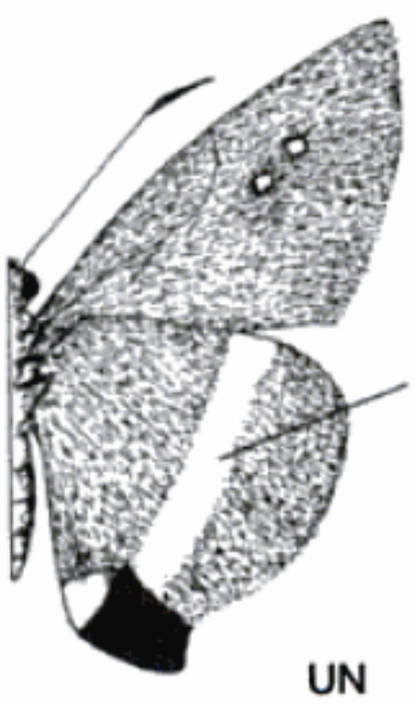
Common Awl



Orange-tail Awl



Plain Banded Awl



White Banded Awl

Status, Distribution and Habitat This is the commonest of the larger skippers near streams and rivers in the plains of peninsular India, where its larval host plant is abundant. It is found in semi-evergreen and deciduous forests of the hilly regions as well, where it is not as common as in the plains. It is widely distributed in the Indian subcontinent, southeast Asia and Australia.

It is more common in the monsoon and immediate post-monsoon months.

Habits This species is more flexible in its habits and habitat requirements than other Awls, which it otherwise resembles. It is found in thick forests as well as in very open areas far away from forests. It flies during the early morning and late evening hours just like its relatives, but also during the afternoon, especially on cloudy days when the sun is mild, although hot sun is not a strict deterrent. It is very wary and takes off if anything moves near it. Its flight is swift but rarely sustained for a long distance and is of a bounding type. However, since it is a strong flier it is a good colonizer of new areas. To do this, it may fly for very long distances, especially in search of larval host plants or mates. The rapid, strong fluttering of its wings during flight is easily audible. It keeps within 3–4 m of the ground.

It almost never basks, but when it does, it keeps its wings slightly open to make a slit through which the upperside of the wings is exposed. For this purpose it sits on the upperside

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of the leaves, but otherwise rests on the undersides of leaves, usually within a few metres from the ground. It is alert even while resting.

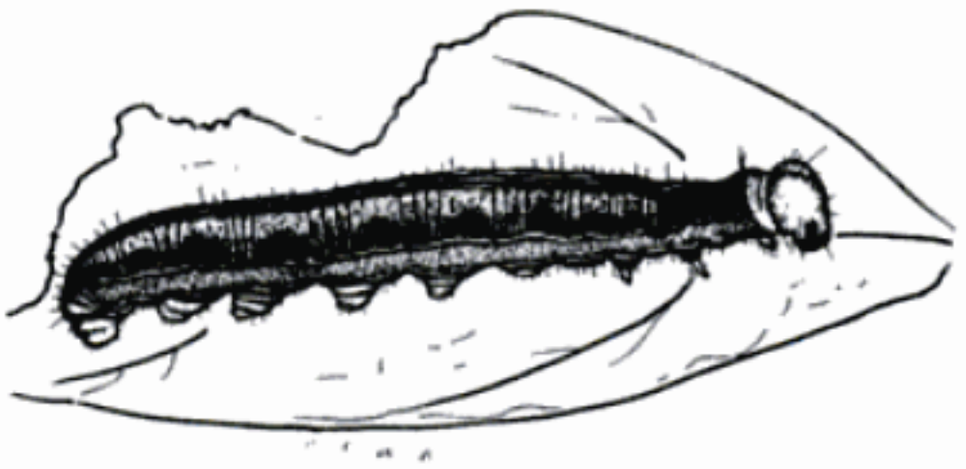
This butterfly comes readily to flowers in the plains, *Lantana* being a favourite, but also occasionally visits wet soil patches. While feeding from the flowers, it does not have to move much to probe in to different flowers from the same inflorescence. It has a long proboscis compared to its body length, which it adjusts to suck nectar from many flowers without moving the rest of its body much.

Due to its occasional population outbreaks, which result from synchronous egg-laying activity because of which many individuals emerge simultaneously, a large number of individuals migrate to surrounding areas.

Reproduction The eggs are laid singly on young shoots, on the upperside or the underside of the budding leaves. The egg is pinkish when it is laid, later it turns dirty white. It is hemispherical and slightly flattened on the top, has minute longitudinal ridges on its surface, which are beaded and transversely finely striated. The little caterpillar that emerges usually does not eat the entire egg-shell, thus leaving behind evidence of its presence. It makes a small cell in the leaf that it eats, is active and moves fast. It hurriedly walks out of the cell if the cell is disturbed and drops from the leaf if the disturbance persists. However, as it grows it becomes lethargic and moves out of its cell slowly even when disturbed. It ventures out to feed only when there is very little light, otherwise rests in the cell that conceals it well. The caterpillar is cylindrical in shape with a small 'neck'—the 2nd segment, which has a jet-black, broad collar and a rounded, slightly lobed, yellowish-red head. Its body is covered with fine, long, erect, white hairs. The colouration and markings on the body are variable. Its back is usually yellowish-white and the sides are pale brown to dark, sooty brown. Sometimes the light colour of the back may be reduced to a narrow band and the caterpillar may look almost black. The lower side of the body is greenish-white, sometimes with a tinge of yellow. In rare cases, the caterpillar is green with the usual dark markings.

The caterpillar pupates on the same plant and close to where it was feeding, in a cell that is closed without major openings on either side. The pupa is pale green on the head, thorax and wing-cases and its abdomen is greenish-brown. The proboscis is slightly longer than the tip of the wing-cases. The pupa has a small but prominent projection on the head between the eyes. Its spiracles are large, oval and light brown. The surface of the pupa is covered with very fine hairs that are visible only on close observation. However, bunches of short and light brown hairs at the eyes are prominent. The eyes slightly bulge out, have a light brown tinge and a curved, oblique pale green line throughout their length. Clustered brown dots are scattered on some parts of the body. For a few days after pupation, a smooth white powder covers the pupa. The pupa shakes when disturbed, sometimes banging itself on the wall of the cell.

Occasionally, in the immediate post-monsoon months, hordes of caterpillars infest trees. They finish off every bit of green and tender tissue of the plant. Because they finish the leaves in which they make their cells, the caterpillars and pupae are exposed through whatever apologies for cells they make in



Length of caterpillar: 30 mm. Length of pupa: 22 mm.

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which to hide themselves. When this happens, predation and parasitization rates increase and the chances of survival of the caterpillars as well as pupae reduce.

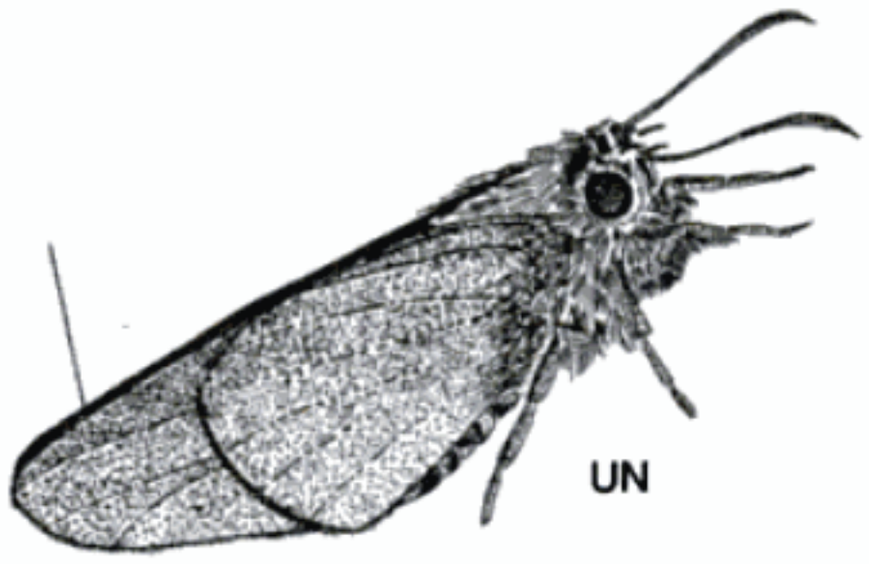
Larval Host Plants Three host plants- *Pongamia pinnata* (Fabaceae), *Ricinus communis* (Euphorbiaceae) and *Trichilia connaroides* (Meliaceae) are recorded. However, the caterpillars are found invariably on *Pongamia*, a small tree that grows close to water, especially along streams and rivers in deciduous forests and on the plains of the Deccan. Other species of *Pongamia* are also likely to be used.

63. Brown Awl

(Plate 28, no. 166)

Scientific Name *Badamia exclamationis* Fabricius

Field Characters Wingspan: 50–55 mm. The brown Awl is a uniformly brown butterfly that is relatively darker on the upperside but very light on the underside. The abdomen is also light brown, with prominent black bands on it. The fore wings have 3–4 small, semi-transparent spots. The male and female are indistinguishable in the field but for these semi-transparent spots, which are larger in the female. The dry season forms may be very small, light in colour and lack the semi-transparent spots on the fore wings. This is an unmistakable butterfly due to its very long and narrow wings and fast flight. In fact, among the Indian butterflies, it has the longest wings in proportion to their width.



Medium-sized, pale brown with pointed, narrow forewings

Similar Species Other Awls, which are mentioned under Common Banded Awl, look roughly similar, but the Brown Awl lacks the white band on the hind wing. The much narrower wings of the Brown Awl and the resulting characteristic shape of its body are very distinctive.

Status, Distribution and Habitat This butterfly is common during the monsoon months in deciduous forests and the post monsoon months in evergreen forests. Although its larval host plants are from moist deciduous and semi-evergreen forests, it prefers openings and edges in evergreen forests to deciduous forests, whenever the former are available. Sometimes this species is abundant and when its population size is at its peak, it may spread to neighbouring habitats, such as shrubs, savannahs or gardens. The species' distributional range covers the whole of the Indian subcontinent, Southeast Asia and Australia.

Habits The Brown Awl flies between about 2 m and 20–25 m, near the bushes and at the

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treetops. The adults feed from flowers of shrubs and small trees and go higher up in the trees to lay eggs, bask, etc. Its flight is very fast and jerky, but not erratic and therefore the butterfly is easy to follow in flight, although occasional flicks in it's flight path may make it difficult. The wingbeats are rapid and powerful and thus quite audible.

It feeds commonly on flowers: *Glycosmis, Lantana, Chromolaena, Buddleia* being some favourites, but also visits bird-droppings and wet soil patches or rocks. The frequency of visiting wet soil patches is higher in the summer or on very warm days in other seasons. It is wary, like the Common Banded Awl, but slightly less shy. Its movements while feeding from flowers are more energetic than most butterflies—it flits from flower to flower, or turns briskly with jerky movements to different flowers from the same inflorescence.

It does not usually bask. When it does, it holds its wings like some moths: flat in the plane of the body with the fore wings covering the hind wings. Thus, it assumes an arrowhead-shape.

When it is not active, it always rests on the undersides of leaves with its head pointing downwards. It rests only in the shade of the forest cover. If it is disturbed it flies around for some time and often returns to the same spot to rest.

Like the Common Banded Awl, the caterpillars sometimes devour all the foodstuff available in an area and the adults are forced to locally migrate to areas where fresh larval host plants are available. Thus, it is among the very few skippers that occasionally migrate.

Reproduction The eggs are laid singly on fresh shoots, but usually many eggs are laid on the plant so there is a high concentration of caterpillars on it. The egg is light green, dome-shaped and has 13 longitudinal shiny ridges that are minutely beaded. The caterpillar, immediately after hatching, builds itself a cell by turning a leaf portion on the upperside and lives in such a cell throughout its life as a larva. The cell is spacious compared to the size of the caterpillar and not tightly woven. The caterpillar is not sluggish and may drop out of the cell and off the leaf on the slightest provocation. It is a strikingly and beautifully coloured insect. Its head is broadly heart-shaped, yellow with a black band and it has spots on the face. The second segment is much smaller than the head and is black with a collar of two yellow bands. The colour of the body is fresh lemon yellow with a blue-black band on lower sides and an interrupted black line on the back. Each segment has a narrow black band on its front and back margins and four black lines between these bands. Its legs are black or chocolate-brown, tipped with yellow. The whole body is bright and shiny. The caterpillar grows considerably faster compared to those of butterfly species of comparable sizes from other families. Its droppings are moist and therefore slightly sticky.

For pupation, the caterpillar always wanders away from the plant on which it fed and may travel as far as 10–15 m from the plant. Even if the caterpillar feeds on the tall *Terminalia* tree, it may come down, sometimes as close to the ground as about a metre, in search of a good place for pupation. Pupation takes place in a spacious cell that is made by folding the leaf margin on its upperside. The cell has two strong threads (see the figure) which hold together the leaf portions firmly and one of these attach the pupa and body-band to the roof of the cell. Inside the cell, the caterpillar weaves an extensive silk bed on which it sits until pupation takes place. It does not hold the silk pad before pupation, but the pupa holds on to it just after moulting. Although it is bound by a tight-body band, the pupa is capable of vigorous movements. Just after moulting, the markings of the caterpillar persist on the pupa for a few minutes, then slowly fade away and permanent markings appear about 12 hours after pupation. The pupa is stout. Its bulging eyes and a round projection on the head in between the eyes are prominent. The pupa tapers off from its shoulders towards the hind portion. There are

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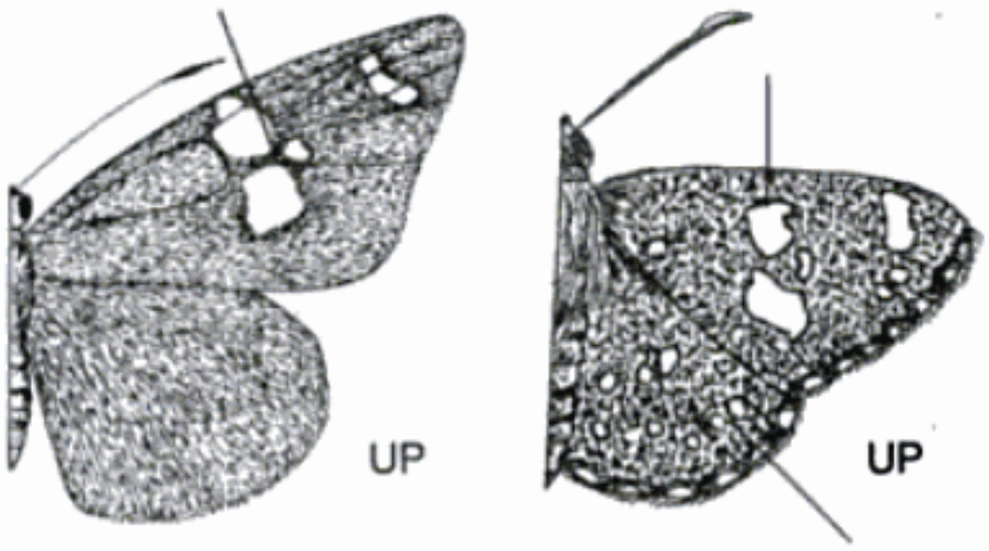

Tamil Spotted Flat ***Malabar Spotted Flat***

streams. Any little, brown, fast and erratically flying insect from such a site is bound to be either a smaller variety of a owl moth or a Malabar Spotted Flat.

The Common Small Flat and the Spotted Small Flat are similar but smaller (wingspan: 30–35 mm).

Status, Distribution and Habitat This butterfly is common in moist deciduous, semi-evergreen and secondary evergreen forests with a predominantly natural, diverse herb and shrub cover. It is particularly frequent in forests with co-occurring patches of dense shade and openings with intense sunlight.

The monsoon and post-monsoon months are the best period for this butterfly. Its population slowly wanes in the winter and summer, increasing again just before the onset of the monsoon.

It occurs in India wherever its forest habitat is present, that is, from the Western Ghats to parts of central India and in the Himalayas and northeastern India. Its distributional range extends to southern China and Myanmar.

Habits It is almost impossible to have a good look at this butterfly, unless one catches it, since it always settles on the undersides of leaves, usually close to the ground, within a metre from the ground. It is also wary, which makes approaching it difficult. During its activity period, it shuttles between patches of shade and light, usually flying in the open patches and going to rest under the leaves in the shade. Its flight is somewhat jerky and so fast that it is difficult to trace the butterfly in the air for long. However, it never flies very far and keeps within 2 m of the ground. On being disturbed, instead of flying away, it usually circles around in the area in spasms of swift flight and finally settles close to the original resting place. This may be due to its territorial habit.

Torben Larsen has mentioned that this species has "...furious early morning patrolling. These patrols are male territorial and mate locating flights covering a length of up to ten metres and they are conducted with such speed that the human eye can barely follow it."

It feeds from flowers but is wary even then. Since its proboscis is long, it often feeds from flowers that have long corolla tubes. Such plants occur very commonly in the dappled light of forest openings, where the butterfly, too, is very common. These flowers include *Impatiens, Asystasia, Blepharis, Peristrophe, Crossandra,* etc., in which acanthaceous shrubs and tall herbs are abundant. Occasionally it visits wet soil patches.

Reproduction The eggs are laid on the uppersides or undersides of young leaves of plants that are found in the cool forest shade. The egg is dome-shaped, green and shiny. Its surface is ornamented with about 60 longitudinal ridges. The areas between the ridges have hexagonal, smooth cells. The newly-hatched caterpillar first eats the eggshell, then goes on to make a cell for itself with a triangular piece of leaf, which it turns over to the upper side of the leaf. The inside of the cell is lined with silk. When the caterpillar grows so big that it can no longer make a cell from a single leaf, it makes a purse of two leaves and stays in between. In the cell, the caterpillar rests with its head turned on the side. If disturbed, it raises its head over the back, with its legs in front and opens its jaws.

The head of the caterpillar is heart-shaped with a flat base, shiny surface and is a dark rufous-black colour. The other end of the body has a rounded anal flap roofing over the clasper. The spiracles are white, small and those on the 2nd and 12th segments are slightly larger. The caterpillar is dark olive green with a darker green pulsating line on the back. A narrow, greenish-white band runs along the spiracles,

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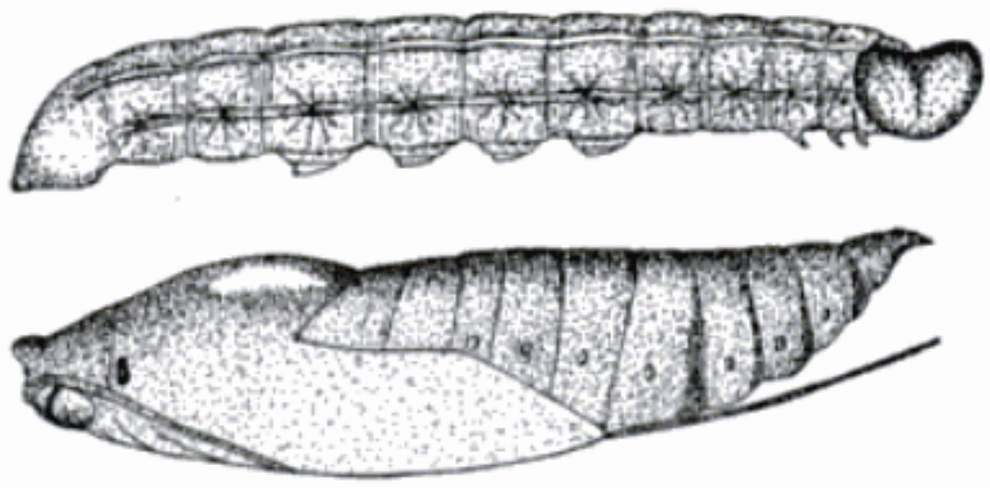
throughout the length of the body. The legs as well as the underside of the caterpillar is pale green. There is whitish, almost invisible hair all over the body, but below the white band on the side it is slightly longer and arises from minute white dots. Its skin is dull and semi-transparent, showing through it the tracheal tubes.

For pupation the caterpillar does not wander, but finds a suitable place close by. The pupa is placed in a cell that may be in a fresh leaf, but more often in a dead leaf on the plant or in the leaf-litter. The thorax is the thickest portion of the pupa and it markedly narrows towards the head, but only gradually towards the abdominal end. The head has a short, rounded projection. The proboscis runs free from the wing-cases along length of the pupa and slightly beyond it. The eyes are large and protrude slightly sideways. The cremaster is strong, curved downwards and triangular. The pupa is firmly attached to the silk-pad by this.



Length of caterpillar: 30 mm. Length of pupa: 25 mm.

The colour of the pupa is a light golden red-brown, the wings are darker. The spiracles are small and each has a thin, white, oval slit, but those on the second segment are enclosed in a slightly raised, dark ridge.

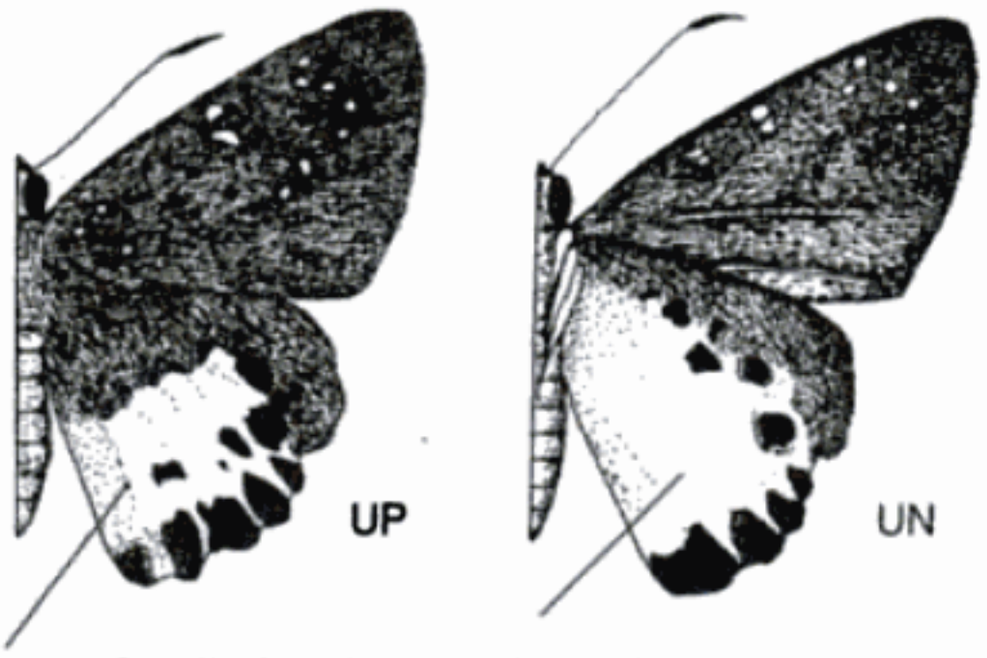
Larval Host Plants All it's larval host plants are common shrubs from secondary evergreen, semi-evergreen and deciduous forests. These include *Asystasia gangetica, Carvia callosa, Ecbolium lingustrinum, Eranthemum roseum* and *Thelepaepale ixiocephala* (Acanthaceae).

65. Water Snow Flat

(Plate 29, no. 169)

Scientific Name *Tagiades litigiosa* Moschler

Field Characters Wingspan: 37– 44 mm. The Water Snow Flat is unlike any other butterfly in the Indian peninsula. It is dark brown with a few semi-transparent spots on the fore wing, but the most distinctive characteristic is the outer two-thirds of the upperside of the hind wings, which are snow-white. A series of large black spots are present at the edge of hind wing, contrasting with the white patch. The male and female are similar.



Small, dark brown with white hind wing

Similar Species Although not so similar in appearance, two species belonging to the same genus are quite similar in habits. These are the Common Snow Flat (*Tagiades japetus* Cramer; which earlier included the Common and Ceylon Snow Flat) and Suffused Snow Flat (*Tagiades gana* Moore; which is also known as the Immaculate or Large Snow Flat) (Plate 29, no. 170). They almost completely share their habitat, but the Water Snow Flat is found in wetter habitats

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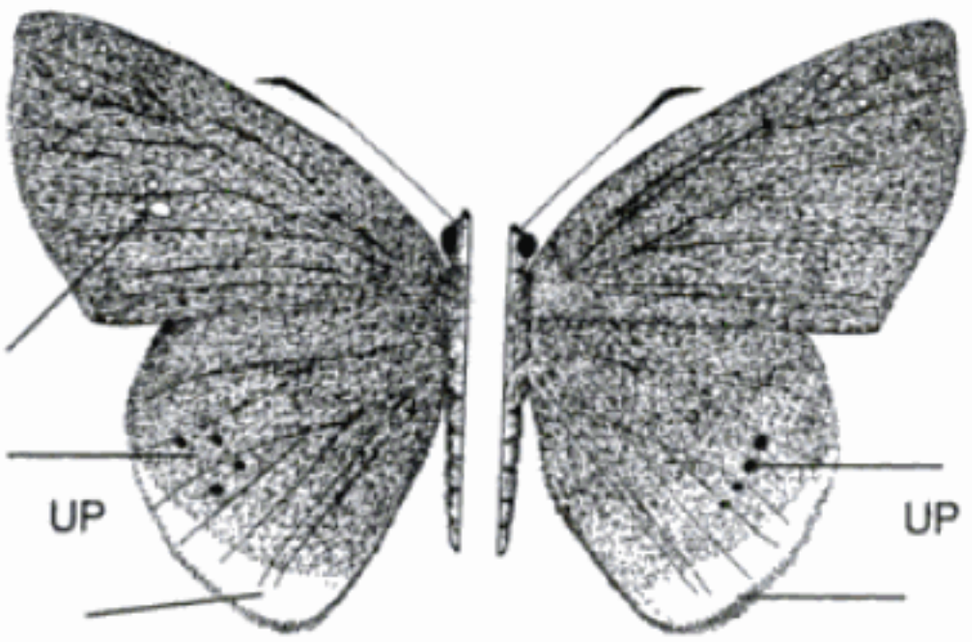

Common Snow Flat *Suffused Snow Flat*

compared to other Snow Flats. The Common and Suffused Snow Flats lack the white patch on the upperside of the hind wing. The underside of the hind wings, however, is white in both these species. They look very similar to each other, except that: i) the Common Snow Flat has two additional semi-transparent spots near the lower margin of fore wing, and ii) the four black spots on the hind wings of the Suffused Snow Flat are in line, those in the Common Snow Flat are not in line.

Status, Distribution and Habitat The Water Snow Flat is common in evergreen, semi-evergreen and relatively undisturbed, extensive, moist deciduous forests. It is more common along paths and other openings in the evergreen forest where deep shade is available, but also in some sunny patches. It is found in suitable forested areas in Sri Lanka, the Western Ghats and central India and from the lower Himalayas east of Simla to northeast India, southern China, extending south to the whole of Southeast Asia.

This butterfly may be found throughout the year. In evergreen and semi-evergreen forests it may be common all year round, but in the deciduous forests may be confined to the wet season and to riparian forests. In any case, it is particularly plentiful in the post-monsoon months.

Habit The first encounter with the Water Snow Flat is often the sight of a dazzling little snowy-white fleck dancing rapidly and erratically in the shade and light of the forest path. Since the fore wings are dark, they are rarely fully visible while the butterfly is flying in the dappled light of the forest, thus only the bright white hind wings are easily visible. The flight is fast and smooth, but with intermittent jerks, sometimes like hovering.

While active, it settles on the uppersides of the leaves, usually near the tips or the edges of leaves, 3–4 m off the ground, thus overlooking the world of undergrowth and small trees from its perch. From this vantage point it carries out dutifully its policing, chasing any other objects that may be flying by. These quarrelsome activities are taken up when it is warming up or after it has fed. For basking, it sits on either the upperside or the undersides of leaves in sunny or shady patches and spreads its wings flat to the leaf. It raises the front legs so that the thorax is also slightly raised. For resting, however, it goes to the underside of a leaf, applies its body close to the leaf and usually chooses shady plants upon which to do so. It is wary and takes to the wing at the slightest disturbance. It is territorial, therefore it flutters around for only a short while and may return to rest under the same leaf, if permitted.

It feeds on flowers and apparently acanthaceous ones, such as various species of *Strobilanthes, Crossandra, Peristrophe*, etc. are preferred. It visits birddroppings lying on the leaves with equal enthusiasm and occasionally visits wet soil.

Reproduction The female lays eggs on the upper side of young leaves. The egg is brown, dome-shaped, with 12 or 13 small ridges running on the surface and is finely sculptured. The egg hatches after 3–4 days, and the caterpillar partly eats the shell and then makes a triangular cell on the upperside of the leaf as a shelter. As the caterpillar grows, it retains the shape of the cell, increasing only the size. It lies stretched on the inside of the roof of the cell, i.e., upside down. It is a fat insect and ventrally flat. The body is smooth and shiny, coloured white with a blue tinge in the front and rear portions and yellow in the middle. These colours are caused by extremely minute dots, each of which bears a still smaller hair.

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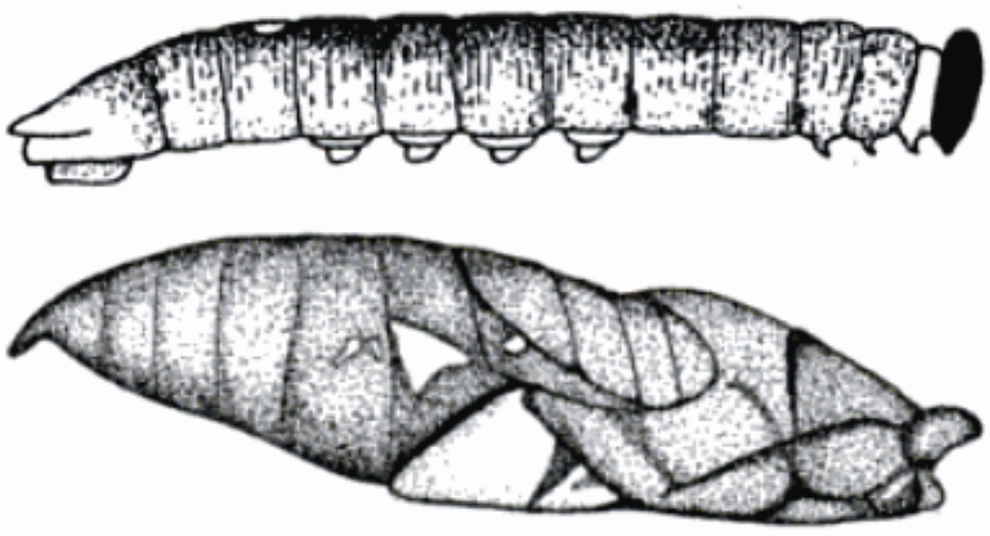
The head is light shiny orange, broadly heart-shaped, with a concave upper edge. The 2nd segment has a shiny brown collar. The spiracles are small. The caterpillar is light orange when it hatches, but turns greenish after eating. It rests during the day in the cell with its head turned around to one side. If touched, it raises its head and thorax and flexes the jaws as if threatening the intruder. It eats only tender leaves when it is young, but afterwards eats mature leaves also.

Pupation takes place in a cell similar to the one in which the caterpillar stays. The pupa is robust and cylindrical, but slightly constricted on the back after the thoracic hump. The head has a pointed conical projection in front. Its surface is smooth and translucent green. It is attached firmly to the silk-pad by the tail and body-band and a silk thread attaches the body-band to the roof of the cell, as is the case with the Brown Awl.

T R Bell reported that in the Uttar Kannada district of the Western Ghats, the caterpillars metamorphose normally in the monsoon, but those growing in December–January remain inactive for a month or two. They may change their cell in this inactivity period, but do not feed. After they pupate, however, the butterflies emerge within the normal period of two weeks without spending any further time in an inactive state. This phenomenon may be geographically more widespread, but has not been reported elsewhere.



Length of caterpillar: 30 mm. Length of pupa: 19 mm.

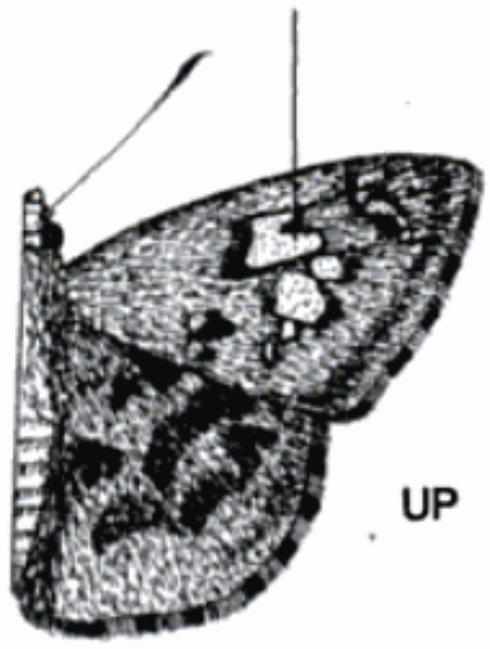
Larval Host Plants The caterpillars feed on climbers: *Dioscorea oppositifolia* and *Smilax* spp., of the families Dioscoreaceae and Smilacaceae. These grow in moist deciduous and semi-evergreen forests and openings in evergreen forests.

66. Fulvous Pied Flat

(Plate 29, no. 171)

Scientific Name *Pseudocoladenia dan* Fabricius (Old: *Coladenia dan* Fabricius)

Field Characters Wingspan: 40– 46 mm. The wings of the Fulvous Pied Flat are dark brown, overlaid with bright rufous scales. The fore wings have large semi-transparent spots, which are yellowish in the male and colourless in the female. The hind wings are marked with diffuse but prominent large, dark spots. The pattern of the spots on the fore wings is characteristic and distinguishes this species from all the other similar species.



Small, bright rufous brown with white and black spots

Similar Species The species most similar to it is the Tricolor Pied Flat (*Pseudocoladenia*

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them. The spiracles of the 2nd segment are set with a semi-circular, small but prominent, furred, chocolate-brown expansion. The surface of the pupa is slightly shiny, coloured light green dotted with brown and with a thin coating of white powder. The pupa, except for the wing-cases, is covered with a dense layer of hair that is longer on the head and the eyes.

Length of caterpillar: 20 mm. Length of pupa: 16 mm.

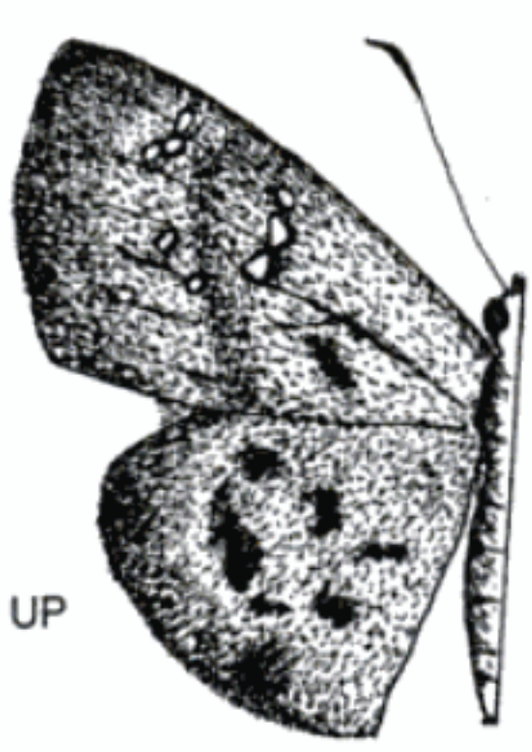
Larval Host Plants The larval host plant is a small herb of the family Amaranthaceae: *Achyranthes aspera*. It is found in the deciduous forests, especially in dry areas, in scrublands and in neglected places around human habitations.

67. Common Small Flat

(Plate 30, no. 175)

Scientific Name *Sarangesa dasahara* Moore

Field Characters Wingspan: 30–35 mm. It is a dull black or brown butterfly with semi-transparent spots on the wings. The underside of the wings is grey-brown with diffused dark spots. The male and female look similar.



Small, dull black or brown with small semi-transparent spots

Spotted Small Flat

Common Small Flat

Spotted Small Flat

Similar Species The Spotted Flats are considerably larger (wingspan: 45–55 mm). The Spotted Small Flat (*Sarangesa purendra* Moore) (Plate 30, no. 176) is similar in appearance to the Common Small Flat. The arrangement of semi-transparent spots on its fore wing is different (compare the illustrations), which is the most definitive feature to separate these two species. Its underside is marked with small white spots.

Status, Distribution and Habitat This species is most common at the end of the rainy season, but occurs uncommonly in the post-monsoon months as well. It is common, though usually not abundant, in almost all habitats except arid ones, where the Spotted Small Flat is common. It occurs in openings and edges in evergreen and semi-evergreen forests, in deciduous forests, scrub and short-grassland–savannahs. It flies on the plains of the Deccan as well as in the hills, but is more frequently encountered at lower elevations. Except for the very dry northwest India, it occurs throughout the country, in Sri Lanka and in the Indo-Chinese region.

Habits This little butterfly flies extraordinarily fast for its size. However, unlike most others of its family, its flight is somewhat erratic and jerky comparatively often. It abruptly

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lands on the substratum while flying very fast, but lands smoothly. It flies close to the ground and sometimes returns to the same spot for perching.

It feeds from flowers of herbs and small bushes. It visits birds' droppings and wet rocks also, but rarely. It always keeps its wings spread. Like the Common Spotted Flat, it goes to rest on the undersides of leaves, but basks on the upper sides with it's wings fully spread.

Reproduction The female lays its eggs anywhere on the leaves, one egg each on its larval host plant, thus widely spacing the eggs and the resultant caterpillars. The egg is dome-shaped, superficially smooth and shiny. Under a powerful lens, however, minute ornamentation of longitudinal ridges and cross-rays is visible. It is pale brown or dirty yellow. The caterpillar eats part of the leaf to make a triangular piece, which is then folded on the upperside and turned into a cell in which the caterpillar stays. It rests on the roof of the cell, with its head turned round on one side. It makes short trips outside to feed. After the second instar, it makes a larger cell by the drawing edges of the leaf together and tying them with silk. At all stages it is a sluggish insect and averse to light, coming out of the cell only late in the evenings and at night. The caterpillar is brownish olive-green with a dark line on the back and a white, thin, interrupted spiracular line. There are yellowish paired spots in between the 9th and 10th segments, which are present only in the male. The last segment bears four long, red hairs.

The pupa is situated in a large cell. It is supported by a loose body-band and tail attachment. A silk thread holds the body-band at one end and the roof of the cell at the other. The pupa is bright emerald-green but its wing-cases are paler. The thorax displays a broadly convex hump. The head is not produced in front, but the eyes are bulging and rounded. The pupa, except for the wings, is clothed in whitish hair, which is long on the head but longer at the eyes.

Length of caterpillar: 20 mm. Length of pupa: 14 mm.

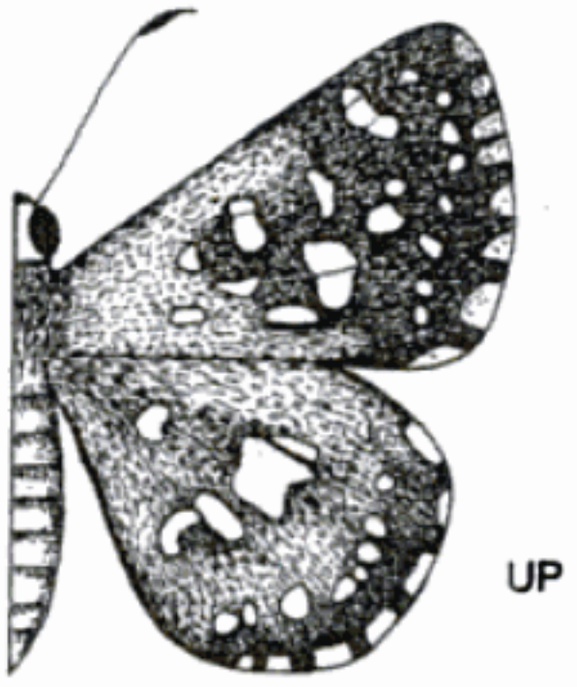
Larval Host Plants Its larval host plants are acanthaceous herbs and small shrubs: *Asystasia* spp. and *Blepharis asperrima*. These species grow in neglected places around human habitations, in deciduous forests and openings in evergreen forests.

68. Indian Skipper

(Plate 30, no. 177)

Scientific Name *Spialia galba* Fabricius
(Old: *Syrichtus galba* Fabricius)

Field Characters Wingspan: 24–27 mm. This species is at once identifiable by its small size and black-and-white wing pattern. The upperside of its wings is black or dark brown, sometimes glossed light rusty-brown and marked with small white spots. The underside is whitish. The hairy fringe of its wings is chequered black-and-white. The male and the female have identical wing markings.



Small, black with white spots

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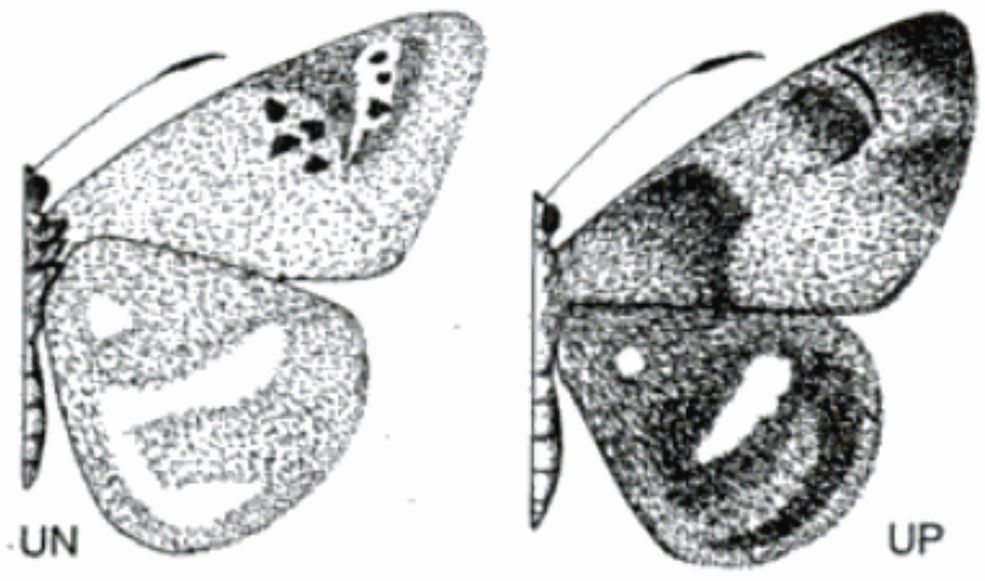
Similar Species The African Marbled or Mallow Skipper (*Gomalia elma* Trimen) is of same size and looks distantly similar. It is olive-brown and marked with small semi-transparent white spots. The fore wings have a black band near the base and the hind wings have a white central band. It is a butterfly from the dry areas.



African Marbled Skipper

Status, Distribution and Habitat This butterfly occurs in the monsoon and immediate post-monsoon months, when the larval host plants and the dry micro-habitats to which it is restricted are green, and is common in this season and habitat. It occurs in all vegetation types from grasslands to forests, except for the driest and wettest. However, it is found always in openings where sunlight is abundant and herb or grass cover is extensive. Thus, its habitat gets seasonally dry. It is distributed throughout the Indian subcontinent.

Habits The Indian Skipper keeps very close to the ground, usually within a metre. It settles on tufts of grass or small herbs, with its wings closed over the back. At any time of the day it may be seen basking with its wings either half-open, or with hind wings held flat in the plane of the body and fore wings at an angle and above them. If disturbed, it flies low but very swiftly and smoothly, taking a winding path in the air. Due to its small size it is difficult to follow, although it usually does not fly far. It is easily overlooked and noticed often only as a small black speck darting from close to the ground.

It is fond of flowers. It sucks nectar from small flowers that are situated a few centimeters above the ground, which include species such as various *Dicliptera, Tridax procumbens, Bidens* spp., etc.

It sleeps on hanging grass blades and on tips of branches of herbs.

Reproduction The female lays its eggs anywhere and in any position on young shoots. The egg is shiny, pale grass-green and dome-shaped. When observed under a lens, about 20 beaded ridges are visible, which climb over the egg surface from the bottom. However, many of them fuse together and finally only 8 reach the top. The caterpillar that emerges is also pale green with a pulsating dark green line on the back. The body is thickest in the middle but it tapers on both sides only slightly and the overall cylindrical shape is retained. The body is clothed in tiny white tubercles, which bear short whitish hairs. A line of long white hair runs along the side of the body, which is more prominent from the 4th segment onwards. The head is covered with long black dense hair, because of which the surface of the face is almost invisible. Its jaws are a dirty orange-red with black tips. The second segment in the 1st and 2nd instar caterpillars is dark chocolate-brown with an inconspicuous, yellow, central bar on the nape. This yellow bar becomes distinct as the caterpillar grows and the markings on the neck become more defined, as illustrated in the diagram. The markings on the sides are orangish. These are surrounded by black borders. The first pair of true legs is black, others are green, the colour of the body. The spiracles are small and brownish-yellow.

The caterpillar stays in a cell that is a good fit for its size. This cell is a folded leaf that is closed tightly from all sides, but for an end through which the caterpillar can come out and feed. From inside it is plastered with silk. The caterpillar rests in the cell with its head turned on its side. It feels uneasy if left outside the cell. It walks slowly and occasionally raises its head and neck shakily, as if groping for cover. On its own, it comes out of the cell to feed only in the late evening and night. Its droppings are very dry and it shoots them far

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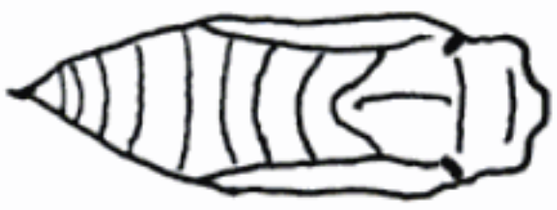
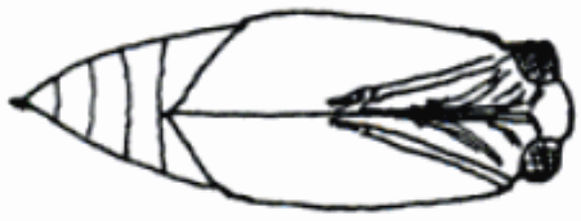
from itself, so that the neighbourhood is kept clean.

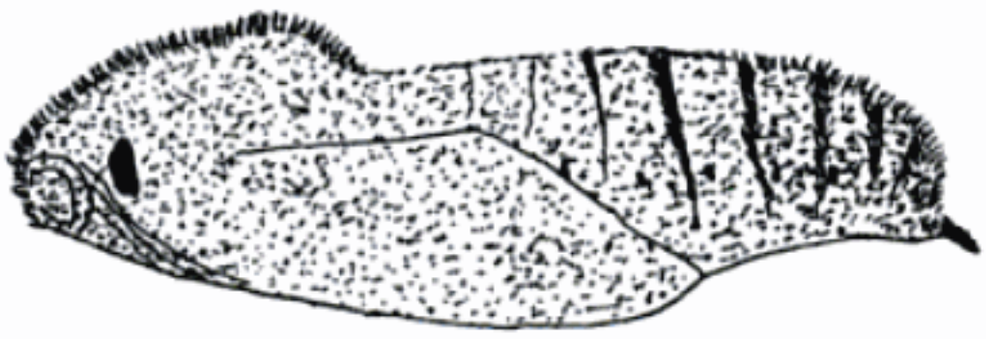
The pupa is thick and strong, more or less cylindrical and tapers off towards the abdomen. The head is wide, the eyes prominent and bulging and the thorax has a slight hump. The pupa, except for its wing-cases, is covered with short but visible greyish-white hair that is longer near the eyes and on the head. It is light green or dirty grey. The spiracles on the 2nd segment are set with large expansions that stand out and are chocolate-brown or black. The pupal cell is more thickly lined with silk than the larval cell. Unlike in most other skippers, the pupa is not supported by a body-band. Soon after pupation, the pupa gets covered with white smooth powder that remains until the butterfly emerges. Four or five days after pupation, the eyes of the pupa turn red-brown, but the colour of the body does not change. Then, as in other butterflies, colours of the butterfly appear on the pupa 10–12 hours before it emerges. The butterfly takes about 8–10 days to emerge.



view from above



view from below



Pupa

Length of caterpillar: 16 mm. Length of pupa: 12.5 mm.

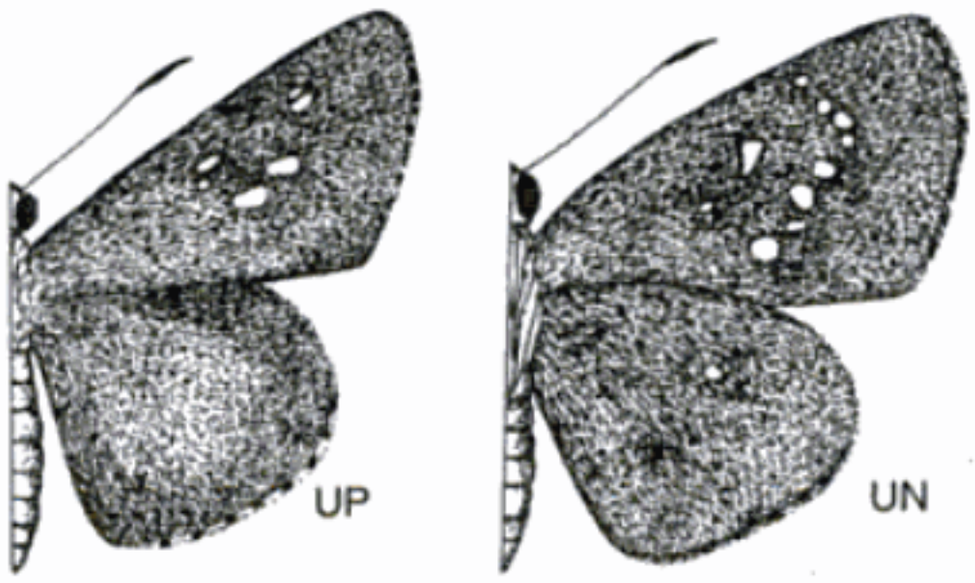
Larval Host Plants The recorded host plants are *Hibiscus* sp., *Sida rhombifolia,* (Malvaceae) and *Waltheria indica* (Sterculiaceae). *Hibiscus* are large shrubs, the latter two are small, much branched, woody herbs. They occur in disturbed places around human habitations, or in dry habitats such as scrub and savannah. *Waltheria* is more commonly and widely used, which is a branched herb with small leaves and grows in grasslands, shrublands and around human habitations.

69. Chestnut Bob

(Plate 30, no. 178)

Scientific Name *Iambrix salsala* Moore

Field Characters Wingspan: 26–30 mm. This is a little butterfly whose wings are dark brown, overlaid with chestnut scales. Apart from its chestnut colour, the only prominent characteristic is a silver spot at the centre on the underside of the hind wing, which is enclosed, in a thin black ring. The upperside of the fore wings may have a variable number



Small, chestnut brown with white spots

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tubercles. The spiracles on the 2nd segment are large, prominently funnel-shaped and coloured red-brown. The rest of the pupa is rusty-brown. A few days after pupation, a layer of smooth white powder covers the pupa and the inner portion of the cell.

Length of caterpillar: 25 mm. Length of pupa: 15 mm.

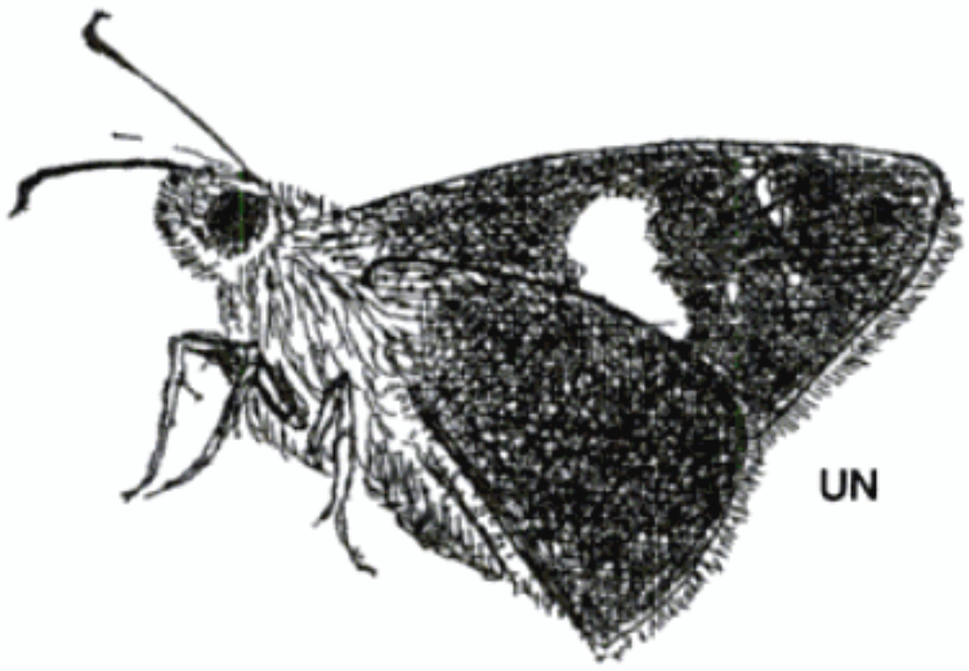
Larval Host Plants The larval host plants are members of Poaceae: bamboos (among which *Bambusa arundinaceae* is recorded) and grasses.

70. Restricted Demon

(Plate 30, no. 179)

Scientific Name *Notocrypta curvifascia* C & R Felder

Field Characters Wingspan: 38–50 mm. It is a black butterfly with a broad, bent, semi-transparent, whitish band and three apical dots on the fore wings. Otherwise it is unmarked. A few pale scales may be present on the underside, especially at the base of the hind wing. The male and female look identical.



Small, black with white band and spots

Similar Species The Common Banded Demon (*Notocrypta paralysos* Wood-Mason and de Niceville) is a copy in shape and markings but for the three apical spots on the fore wing, which it lacks. The Common Banded and Restricted Demons have identical habits, but in southern India the former is less common and found in denser, moister evergreen forests compared to the latter. The Grass Demon is completely dissimilar in appearance, but similar in habits to the other two Demons. It is found in more open and drier habitats. It flies a bit faster and has a unique wing-flashing display, which the other Demons lack.

Status, Distribution and Habitat The Restricted Demon is found in undisturbed or less disturbed moist deciduous forests, or in semi-evergreen and evergreen forests. However, in the evergreen forests it is seen mostly in openings and edges, where light is ample. In the deciduous forests it is more frequent close to forest streams or otherwise moist and shady places.

The adults are active in the monsoon and post-monsoon months, get rarer in the winter and almost vanish in late winter and summer. The species' distributional range covers Sri Lanka, the Western Ghats south of Goa, the Himalayan foothills east of Himachal Pradesh, then to southeast Asia up to Sunda islands. The Common Banded Demon shares the entire range.

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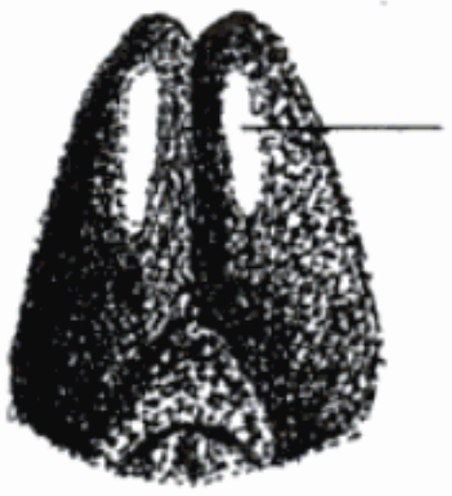
Habits It settles low on bushes and herbs and does not stray far, so its activities are restricted to a small area. Its flight is fast, but always close to the ground and in short bursts.

The Restricted Demon is an ardent visitor of flowers, which forms the main source of nutrition for it. Since it has an extremely long proboscis compared to its body (see description of the Grass Demon pupa, which this one resembles), it can feed from a wide variety of flowers with a range of corolla tube lengths. A diverse herb and shrub cover in its partly shaded and partly semi-open forest habitat offers this floral variety. It also visits exotic plants such as *Lantana* but indigenous plants, e.g., *Asystasia, Blepharis, Elephantopus, Peristrophe*, etc. are preferred. A simple explanation for this preference is that this species is more common where there are fewer disturbances, therefore there are more indigenous plants than exotic weedy species available as nectar sources.

It is more active in the morning and evening, but there are no strict rules for the time of activity. In the forests, light and temperature conditions greatly influence its activity in local patches.

The basking posture is typical of the skippers—hind wings spread flat and fore wings held at an angle above the hind wings, or sometimes both wing pairs held together and half-open.

Reproduction The reproductive behaviour and physical appearance of larval and pupal stages of the Common Banded and the Restricted Demon greatly resemble that of the Grass Demon. The general behaviour of the caterpillars is identical. The caterpillar is of same shape and green with a black head. There are two major differences. The first is that the Restricted Demon caterpillar has a pair of vertical white stripes on the face, which may be restricted to the upper half of the face, or extend from the top to the base of the face. The second difference is that it has a white spot behind each proleg. The pupa also is same.



Face of the caterpillar

Length of caterpillar: 40 mm. Length of pupa: 30 mm.

Larval Host Plants This species feeds on plants that are similar to the ones that the Grass Demon uses: tall herbs with long, narrow leaves, underground rhizomes, which grow in the shade of moist deciduous, semi-evergreen and evergreen forests. The species recorded are *Costus speciosus, Curcuma decipiens, Hedychium(?), Kaempferia rotunda* and *Zingiber montanum* (all plants from the family Zingiberaceae: relatives of ginger, turmeric, etc.).

71. Grass Demon

(Plate 30, no. 180)

Scientific Name *Udaspes folus* Cramer

Field Characters Wingspan: 40–48 mm. The Grass Demon is black with a big white spot on the hind wing and several smaller white spots on the fore wing. The underside of its wings is predominantly white with brown edges and spots. The male and the female look similar.

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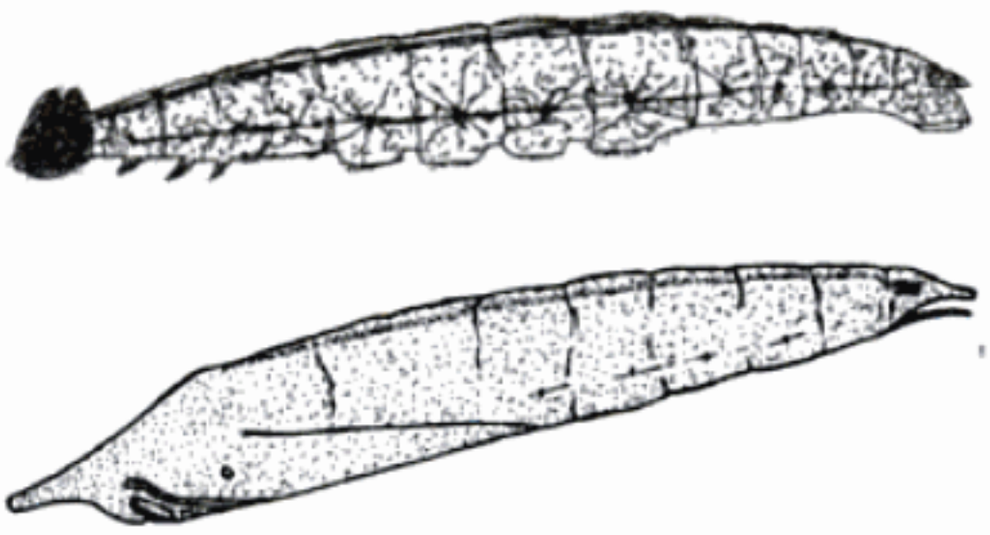
of the adults. It rarely visits dung and bird-droppings.

Reproduction The female spends some time in the vicinity of the larval host plant, landing and taking off from the leaves to survey the available resources and potential sites for laying eggs. Once it has made up its mind, it sits on the upperside of a leaf, bends only the tip of the abdomen, deposits usually one egg, occasionally two or three and immediately takes off. The egg is superficially smooth, low, dome-shaped, with 48 longitudinal white ridges and tubercled minute ornamentation on the surface. It is red when fresh, later turning whitish with a red top.

The caterpillar does not completely consume the eggshell. Soon after hatching, it makes for itself a spacious and well-ventilated cell. In this cell, it lies contracted and therefore hunched. It is sluggish, shy and so feeds only at night and during the early morning and late evening hours. Even if disturbed, it is reluctant to leave the cell. During the rains, sometimes the cells get completely filled with water, and the caterpillars drown and die, but do not leave the cell. The caterpillar is a uniform light leaf-green with a dark green, pulsating line on the back and an unmarked black head. The head is small compared to the body, but the neck is much smaller and yellowish. A few hours before the caterpillar moults, its head looks pinkish-white and turns black only after the moulting and drying of the new skin is complete. The skin is thin and semi-transparent, through which tracheal tubes are visible. The spiracles are small and whitish, situated on slight swellings. Under the 2nd segment, close to the head, is a small orange or pale saffron gland that is usually retracted. When the caterpillar is handled, the gland protrudes. This gland cannot be smelled by human beings and exudes no visible amount of defense chemicals. Its function is not known.

Pupation takes place on the same plant, often on the same leaf on which the caterpillar last fed. The pupa is long and cylindrical, with a longish, conical, pointed projection in front of the head. The eyes are of moderate size and do not stand out of the pupal outline. The pupa broadens at the shoulders and gradually tapers until the last segment. The spiracles are small and pale. The cremaster is flat and triangular. The most striking characteristic of the pupa is its proboscis, which is not thick, but very long. It extends beyond the wing-cases after which it is detached from the main body of the pupa, stretching slightly longer than tip of the abdomen. The pupa is of the same colour as the caterpillar and unmarked. It is enveloped in a thin, sparse layer of white powder. The body-band is neither very tight nor very loose, therefore the pupa can wriggle if disturbed.

Most caterpillars that pupate later in the season, i.e., in September–October, remaining dormant for five to seven months. The butterflies emerge from these in February or March and lay eggs before they die. These eggs remain dormant until May when the rains begin. It is possible that some of the pupae formed late in the season remain dormant until May of the next year. The dormant pupae are usually brown in colour.



Length of caterpillar: 40 mm. Length of pupa: 33 mm.

Larval Host Plants The Grass Demon feeds on ginger, turmeric and their relatives: *Curcuma aromatica, Curcuma decipiens, Hedychium* sp. *and Zingiber* sp. (Zingiberaceae). These plants are tall herbs with long, narrow leaves, underground rhizomes and they grow in the shade, mostly around streams, in the moist deciduous, semi-evergreen and evergreen forests.

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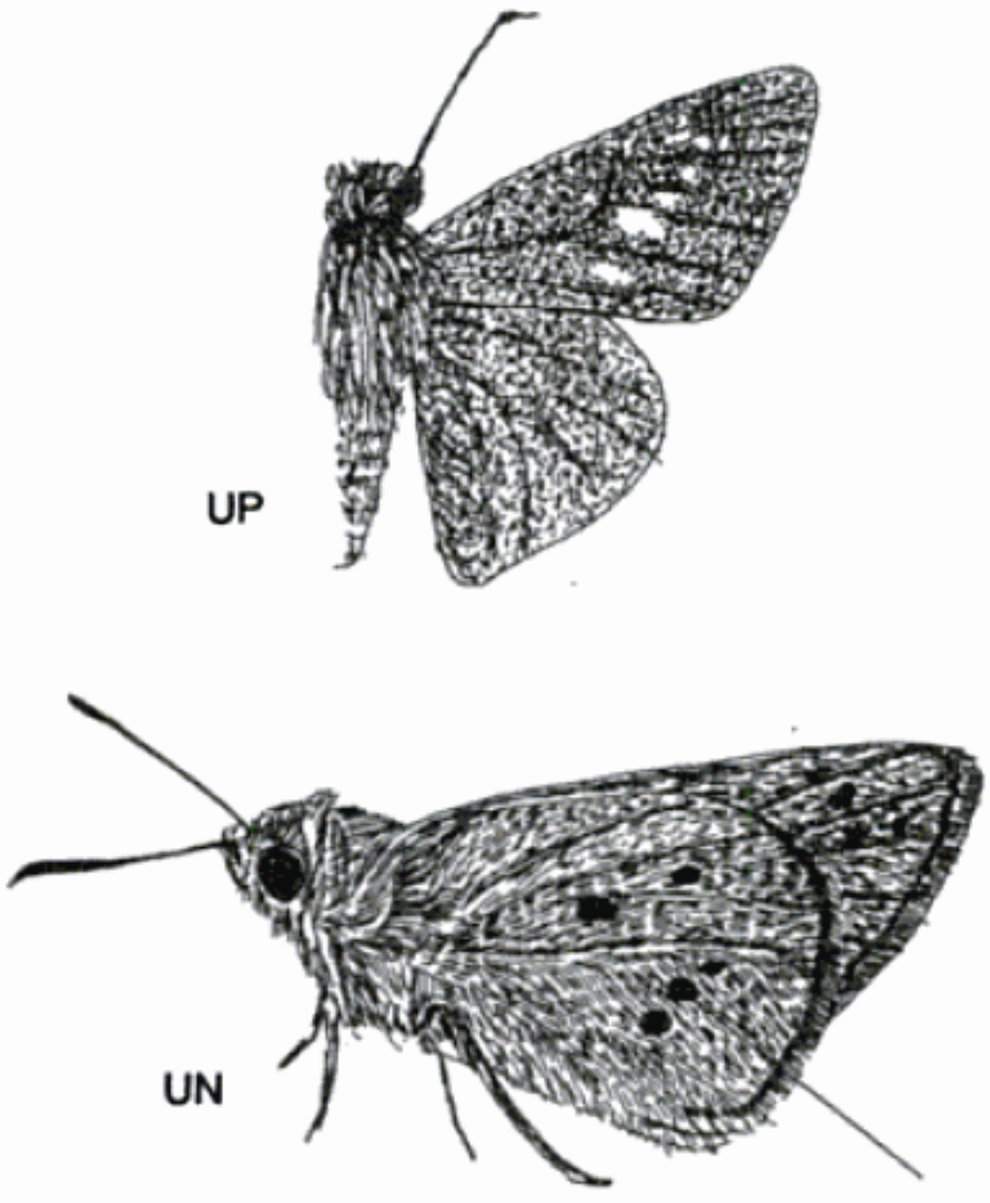
Economic significance This species is considered an occasional pest of ginger and turmeric, but it does not do any serious damage to the plants. Although sometimes the concentration of caterpillars on a plant or in an area is high, the caterpillars never eat all the leaves. Therefore, production is not much affected.

72. Indian Palm Bob

(Plate 31, no. 181)

Scientific Name *Suastus gremius* Fabricius

Field Characters Wingspan: 32–42 mm. The Indian Palm Bob is easily distinguishable from other Skippers by the pattern of black spots on the underside of its hind wings. Its wings are pale brown sprinkled with grey scales and with five sharply defined, small, black spots. Three of these are in one line, two opposite to these three. These spots may be sometimes very small or faint, but are always present in the same pattern. There are semi-transparent spots on the fore wings. The male and female are identical in appearance.



Small, pale brown with semi-transparent and black spots

Similar Species Given the characteristic spots on underside of the hind wings, this species cannot be confused with any other butterfly in India. However, in size and shape it may look superficially similar to the Swifts (*Borbo* spp.).

Status, Distribution and Habitat This is overall an uncommon butterfly, but may be commonly found around palms on which its caterpillars feed. It is present in all habitats in which various palms occur—evergreen, semi-evergreen and deciduous forests, rocky hill slopes and plateaus, coastal areas and human habitations. It is distributed throughout the Indian subcontinent and Indo-China.

Habits This is an extremely busy butterfly, constantly on the move and therefore hard to observe for a length of time. This was described by T R Bell: "It… never dawdles about or flutters or hovers: it is suddenly there, on a flower or on a leaf and, the next instant, it is gone..". Its flight is very strong and swift. It flies smoothly in a straight line when the flight path is clear, winding occasionally to avoid obstructions and navigating itself expertly and rapidly through vegetation. It covers long distances in a single flight and therefore is difficult to trace once it takes off. The task of tracing it is further complicated by its habitat use because it flies in all vegetation layers: from ground level to tree-tops.

It is happy with a variety of food sources—flowers, wet soil patches and bird-droppings. There does not seem to be a particular preference for any one of these, the butterly feeds on them probably whenever they are

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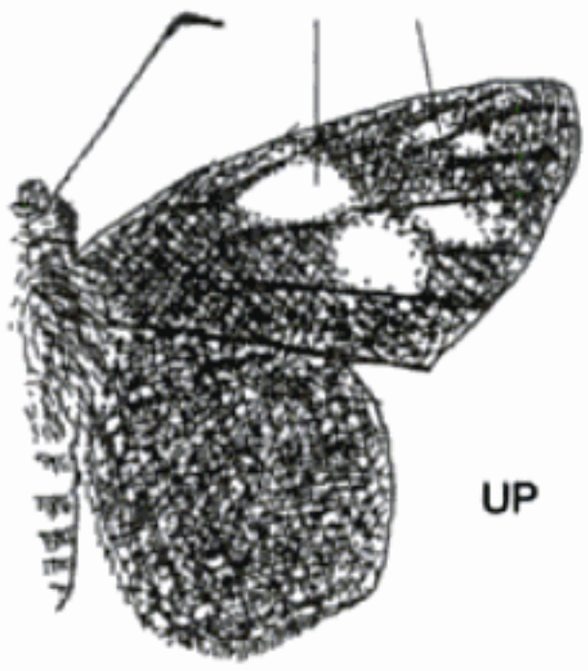
73. Giant Redeye

(Plate 31, no. 182)

Scientific Name *Gangara thyrsis* Fabricius

Field Characters Wingspan: 70–76 mm. This is the largest Skipper from peninsular India and among the largest from India. Its other distinctive characteristics are its chocolate-brown wings, with three large and three small apical, yellow spots on the fore wings. The underside of the hind wings is heavily dusted with grey scales, which form obscure bands. The eyes are large and vine-red. The two sexes look similar.



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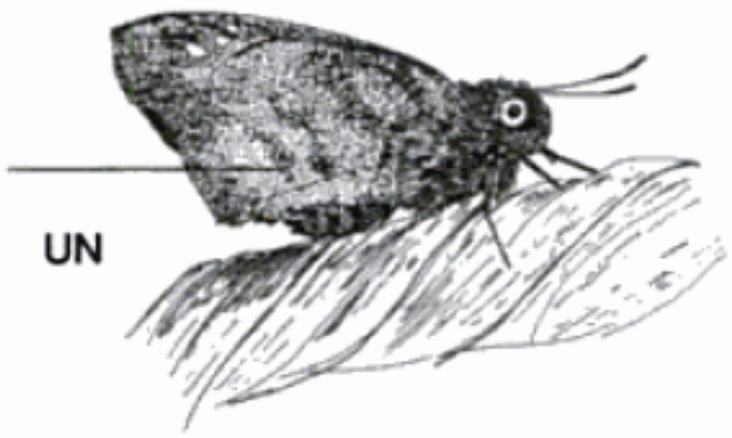

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Medium-sized, chocolate brown with yellow spots

Similar Species The Palm Redeye (*Erionota thrax* Linnaeus), which is of the same size, is also very similar in appearance: brown wings with 3 large, yellow spots on the fore wing. However, it is paler brown, lacks small, apical, yellow spots on the fore wings and its underside is plain pale brown, not dusted as in the Giant Redeye. It is recorded most probably as a stray specimen from the Western Ghats, but is quite common in the Himalayan foothills. The Common Redeye (*Matapa aria* Moore) is much smaller (wingspan: 40–55 mm), plain brown without any markings, but as in the Giant Redeye its eyes are red. The border of the hind wings is hairy and grey or pale yellow.

Status, Distribution and Habitat Judging by the abundance of its caterpillars, the Giant Redeye is a common butterfly, in fact in some places very common, but is not seen often due to its crepuscular habits. It occurs in evergreen and semi-evergreen forests, where its larval host plants, various species of palms, are relatively more common. However, due to the extensive cultivation of coconut or ornamental palms, it is abundant in most of southern India. It is distributed in Sri Lanka, the whole of southern India, northeast India and the rest of the Indian subcontinent.

It is seen throughout the year, although it is uncommon during the heavy rains, but common from the post-monsoon to pre-monsoon months.

Habits This Skipper is strictly crepuscular in it's habits. It flies only after dusk and during the early night, therefore once in a while is attracted towards light. During the daytime it rests on vertical planes in dark places at any height from the ground, with the fore wings drawn between the hind wings, antennae lowered and head pointing upwards.

At dusk it starts its activity. Given its strong thorax and narrow fore wings that are suitable for swift flight, it can fly at any height from the ground or for long distances to forage. Thus, it flies high up in the trees as well as close to the ground. Its flight is extremely fast, winding and often long sustained. The wingbeats are so powerful and quick that they are audible from a distance of a few metres during the silent hours of the night. A few individuals may occasionally be seen together while they chase each other away and quarrel over a vantage point.

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It is fond of feeding from flowers, which seems to be it's sole source of nutrition. It has an extraordinarily long proboscis—long, both absolutely and in comparison with its body length and therefore is able to suck nectar from largest flowers available in the forests, e.g., the flowers of *Hedychium* and *Costus*. It is always wary, but more so when it is active and takes off at the slightest disturbance.

Since it is a crepuscular–nocturnal butterfly, it never basks.

Reproduction The female lays one egg at a time on the upper surface of the palm leaflet. The egg is dome-shaped, whitish and slightly shiny. The caterpillar is cylindrical and rounded at the end. The thoracic segments, neck and head are much smaller in comparison with the body. The head is broader at the base and rounded, but narrow on the top. It is dark chocolate-brown in colour, though it looks white due to a thick coating of powder that covers it's entire body. The caterpillar secretes this powder which forms soft pillars on the body and completely hides it's surface. The actual colour of the caterpillar, seen when this powder is removed, is light green or brown. There are reddish-brown markings on the back, which can be seen only when the amount of powder on the caterpillar is less. The amount is less when the caterpillar moults and when it is very young.

Immediately after hatching, the caterpillar folds a triangular portion from the edge of the leaflet, usually close to its tip and makes a tubular cell for itself. Later, when it is older and needs more food to eat, it makes a cell somewhere in the middle of the leaflet, eating only that portion which is in front of the cell, up to the tip. The inside of the cell is very densely lined with silk. The discarded half-eaten leaflets and cells are visibly lined with silk. The caterpillar rests in the cell with its head and thorax up to the 4th segment turned to the side and its body oriented towards the widely open end of the cell, which is towards the leaflet end. It is sluggish and unwilling to move even if the cell is opened. If forced to walk, it moves very slowly and haltingly. It comes out from the cell only to feed and only in the late evening, at night and early in the morning. While feeding, it makes a gnawing sound, which, especially in the case of leathery and tough coconut leaves, may be audible even a few metres away. It grows very slowly and needs many leaflets to finish its growth.

The caterpillar never walks far from the plant and pupates on the same leaflet or leaf. The pupal cell is a spirally-coiled leaflet that makes a wide tube with lot of free space around the pupa and is sprinkled from within with white powder. It is tightly closed towards the petiolar side of the leaflet, where the front portion of the caterpillar is situated. The other end is wide open, through which the cremaster and abdominal segments of the pupa can be seen. The pupa is longish but stout. It is slightly humped at back of the thorax but sloping gently at all sides. The most striking characters of the pupa are its proboscis and cremaster. The proboscis is the longest compared to the body among peninsular Indian butterflies and is uniquely curved. It runs free from the tips of the wing-cases, takes a complete turn around itself and ends near the abdominal tip (see the illustration). It can be as long as 47 mm if measured from end-to-end. The cremaster is thick, triangular, down-curved and armed with processes on the sides. The body-band is absent but the pupa is attached firmly by the cremaster to a thick pad of silk. There are two ridges on the 9th and 10th segments, through which the proboscis case passes. When the pupa is disturbed, the proboscis is rubbed against the ridges, which produces a hissing sound. Because of its spacious cell and the absence of the body-band, the pupa can violently vibrate within the cell, in the process banging itself hard on the walls of the cell. This makes a drumming sound and shakes the cell. This is a strategy used when the pupa is disturbed.

After a period of more than 10 days, the butterfly emerges usually during the early hours of the night. The wings first open

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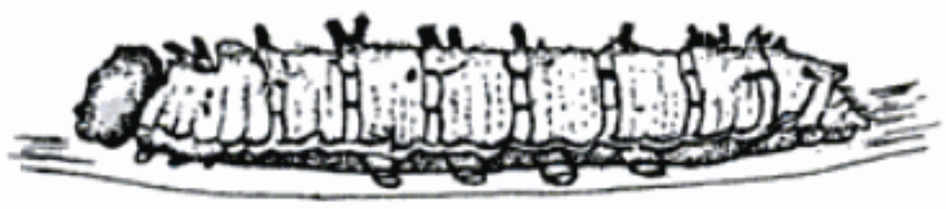
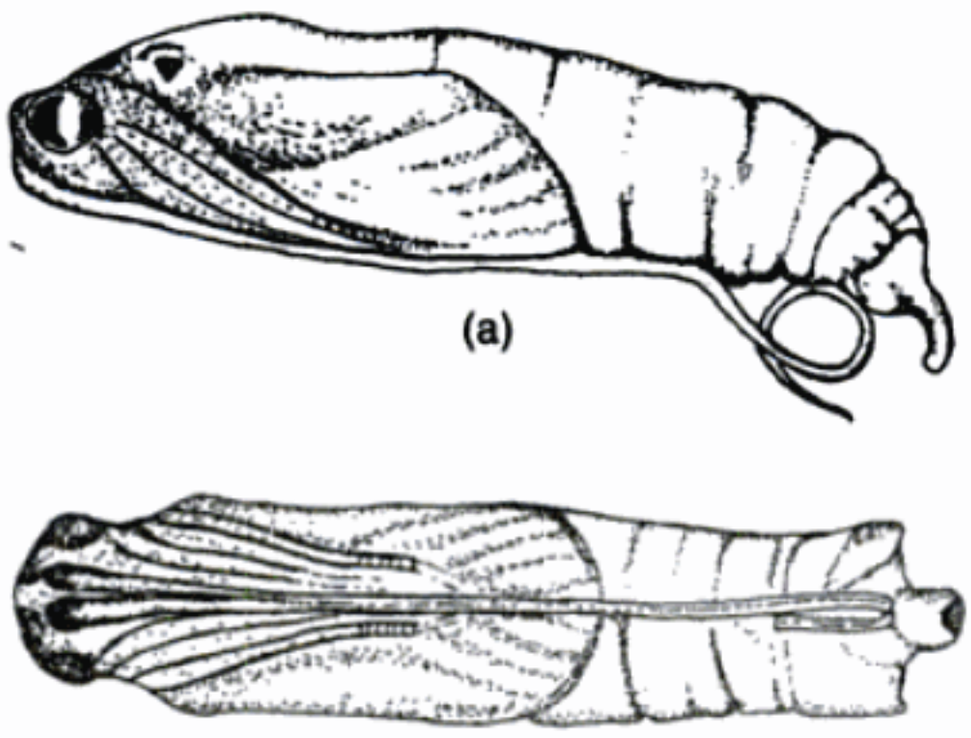
completely and as they become dry, a fold develops at the inner margin of the hind wing.

Sometimes many females lay batches of eggs on the same palm plant. In such a case, many eggs fall prey to ichneumon wasps. The wasps lay their eggs inside the Redeye eggs, their larvae feed on the egg-contents and pupate there. After their metamorphosis is complete, the adult wasps emerge from the butterfly eggs by puncturing holes on top. As many as 70% of the eggs on densely populated plants may be lost to ichneumons.



Larva



Pupa (a) view from side (b) view from below

Length of caterpillar: 45 mm. Length of pupa: 35 mm.

Larval Host Plants This is amongst the most polyphagous butterfly caterpillars in India. It feeds strictly on palms (Arecaceae), but on a wide variety, which include indigenous as well as exotic species: *Calamus rotang, Caryota urens, Cocos nucifera, Licuala grandis, Phoenix acaulis, Phoenix lourierii*, some ornamental species, etc. Some of these are small, bushy palms, others are tall species. There could be local preferences for certain palm species over the others. But the caterpillars readily accept any palm that is offered. Coconut trees, are usually utilized everywhere and very commonly.

Economic significance The Giant Redeye caterpillars sometimes devour large portions of palm leaves and therefore the species is considered a pest on coconut and other palms. Damage by this species, however, is less compared to other pest species, such as the red palm weevil (*Rhynchophorus ferrugineus*) and the rhinoceros beetle (*Oryctes rhinoceros*), which may destroy stems and young shoots.

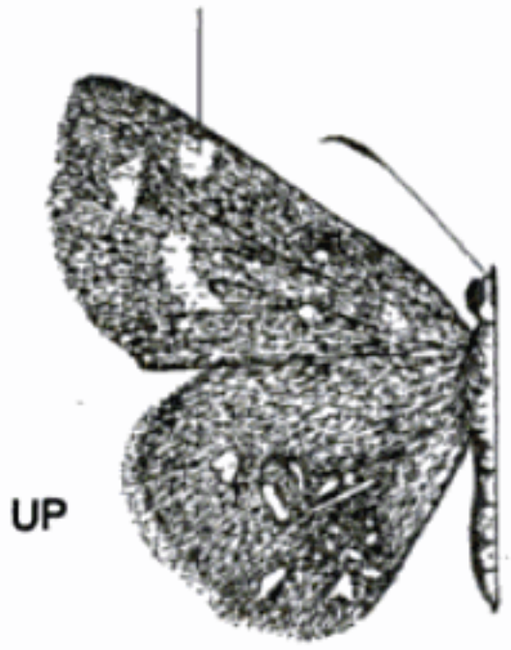
Suggestions for student projects Refer to section 2f. Seasonality and Flight Periods.

74. Tamil Grass Dart

(Plate 31, no. 183)

Scientific Name *Taractrocera ceramas* Hewitson

Field Characters Wingspan: 23–30 mm. The Tamil Grass Dart is a tiny butterfly with dark brown wings that are marked with yellowish-orange, small spots. Its small size, dark brown wings, spots near the apex of the fore wings and their arrangement, and the habitat in which it is found, makes it quite an easy butterfly to distinguish from other small



Small, brown with yellowish-orange spots

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Skippers. The male and female cannot be distinguished in the field.

Similar Species The Common Grass Dart (*Taractrocera maevius* Fabricius) (Plate 31, no. 184) is similar in size and markings, but the spots on the fore wings are white. It shares its habits and habitat with the Tamil Grass Dart. However, unlike that species, it is also found away from the hills and is widespread in the plains of Indian peninsula.

Status, Distribution and Habitat It is one of the commonest of the skippers in the grasslands of the Western Ghats and occurs from low elevations up to montane grasslands. It is also found in grassy clearings in the forests and in rice fields. It occurs in the monsoon and immediate post-monsoon months when the vegetation is green, but occasional specimens may appear in other seasons as well. Outside southern India, it is found from Manipur to the north and to the east till southern China.

Habits The Tamil Grass Dart is a butterfly that is noticed in its open habitat often while it darts from flower to flower. Flowers seem to be major source or perhaps its only source of nourishment. It has a rather long proboscis for its body size and for the flowers found in the grasslands which usually have short corolla tubes. Yet, it seems to prefer only smaller flowers, such as *Diclipetra roxburghiana* and certain asteraceous species.

It flits close to the ground, never quite rising above the herb–grass layer even while in flight. Its flight is weak, but it is difficult to track it due to very small size and inconspicuous colours. It flies in short bouts, but usually does not return to where it began. It basks with the hind wings spread flat and the fore wings half-open. When it is active, it sometimes keeps busy chasing other butterflies of its own species.

Reproduction The eggs are laid usually on the undersides of the grass-blades, but otherwise anywhere. The egg is dome-shaped and light yellow when it is freshly laid. Soon it develops an irregular, broad, red band at the base and a red blotch on the top. Its surface is covered with superficial, fine-walled, hexagonal cells that are visible only under a microscope. The caterpillar hatches within 3 to 5 days. After its first meal of the eggshell, it proceeds to the tip of the blade and makes a roomy cell by joining the edges and lies in it on the mid-rib. Such a cell and resting position is retained until it pupates. From the cell it makes trips outside to feed during the night and at dusk and dawn, but at any time on dull days. It is very active, quick-footed and runs out of the cell, curling and dropping to the ground if the need arises or if it is disturbed. It is the same shape as the caterpillars of the Demons, but with a larger head and neck. The head is rough, black in colour and with two dirty white, narrow bands on the face which run towards the high points on the head. Two such bands on the cheeks, one on either side, join these at the top. The second segment has a chitinous black collar that runs from spiracle to spiracle. The body surface is covered with minute brown tubercles, each bearing a small hair and visible under a lens. The spiracles are small and light yellow. The legs are whitish or yellowish. The body is light green, dotted with darker green. It is marked with a dark purple line on the back, two obscure lines on the sides and a yellow sub-spiracular line.

Pupation takes place often in a cell in a withered leaf, which sometimes falls to the ground. The pupal cell is a close fit for the size of the pupa, tightly closed from one end and lightly from the other, through which the butterfly emerges. The pupa is not attached to the cell, it just lies inside it. The cell and the pupa are covered with a white waxy powder. The pupa is cylindrical, of almost even diameter from the shoulders to the 9th segment, then rapidly sloping. The eyes are prominent. The proboscis reaches up to the 9th segment, lying free beyond the wing-cases. There are long reddish hairs at the eyes and anal segment, the other hairs are very small and scattered on the body. The spiracles on the 2nd segment have a large, oval, convex, red plate—the others are small and yellow. The pupa is dirty yellowish with a red end.

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T R Bell, in Uttar Kannada, reported that caterpillars stayed inactive for four months, from end of October to February, pupated in February but then the butterflies emerged within a week's time.

Length of caterpillar: 20 mm. Length of pupa: 13 mm.

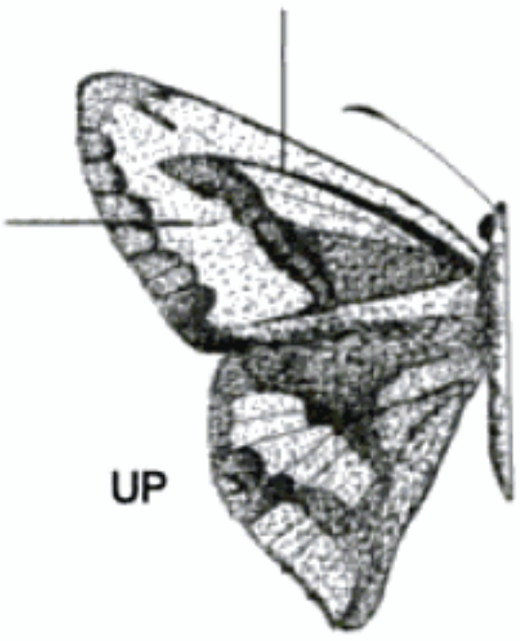
Larval Host Plants The caterpillars feed on various species of grasses, including rice (*Oryza sativa*).

75. Dark Palm Dart

(Plate 31, no. 185)

Scientific Name *Telicota ancilla* Mabille
(Old: *Astychus pythias* Mabille)

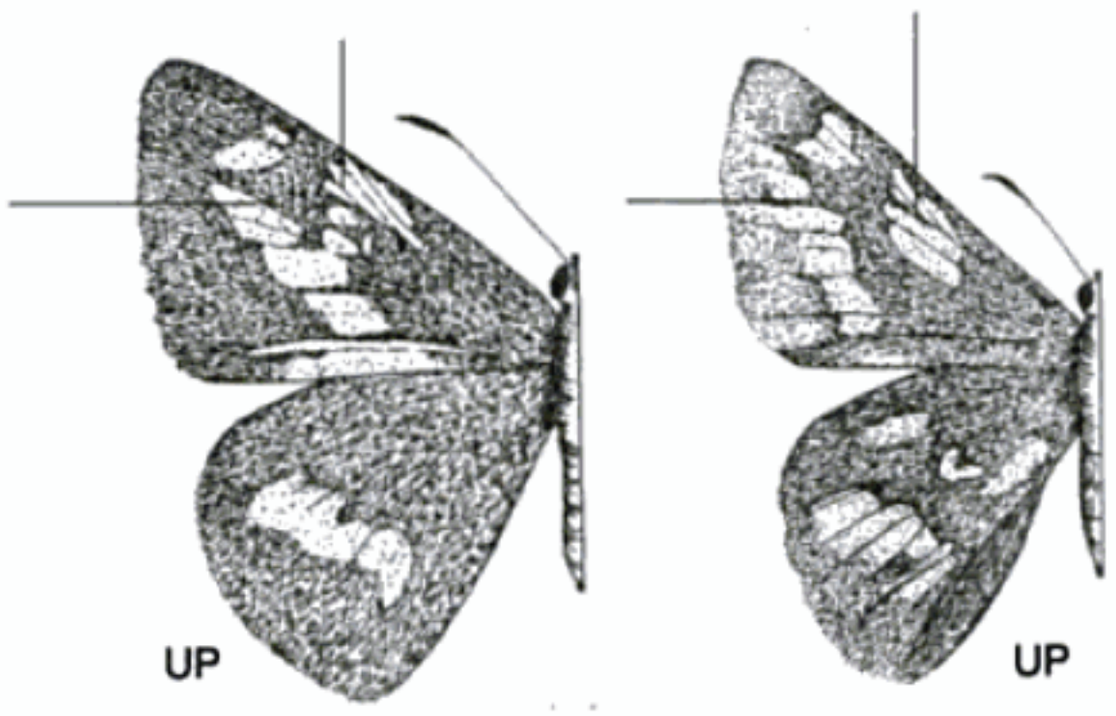
Field Characters Wingspan: 34–36 mm. This is a black butterfly with orange bands on the fore wings, which narrow towards the apex. The hind wings are black with a pale orange band. The male and female have identical markings.



Small, black with orange bands

Similar Species The Pale Palm Dart (*Telicota colon* Fabricius) is very similar in markings and morphology, so much so that these two Palm Dart species were once thought to be forms of the same species. In the case of the Pale Palm Dart, the veins on the fore wing are yellow and their colour extends up to edge of the wing. However, there is great variation in these characteristics and very similar individuals of the two species can sometimes be difficult to distinguish from each other. Other similar Skippers include the Darts (*Potanthus* spp.) and Dartlets (*Oriens* spp.). Although they may look somewhat similar at first glance, these are considerably smaller species (wingspan usually between 23 and 30 mm) and their markings are also different (see the illustrations). However, there are different species of Darts and Dartlets, distinguishing between which is not an easy job.

The Darts and Dartlets occur in thicker and moister forests. The Pale Palm Dart prefers drier and more open areas as compared to the Dark Palm Dart.



Common Dartlet ***Common Dart***

Status, Distribution and Habitat The Dark Palm Dart is a butterfly of mostly hilly, wooded areas, usually in deciduous forests and is ranges from common to slightly uncommon in these habitats. It occurs also in the plains and dry areas, but is not as common in these areas. It is found in Sri Lanka, throughout India except the very dry northwestern parts and extends into Southeast Asia and Australia.

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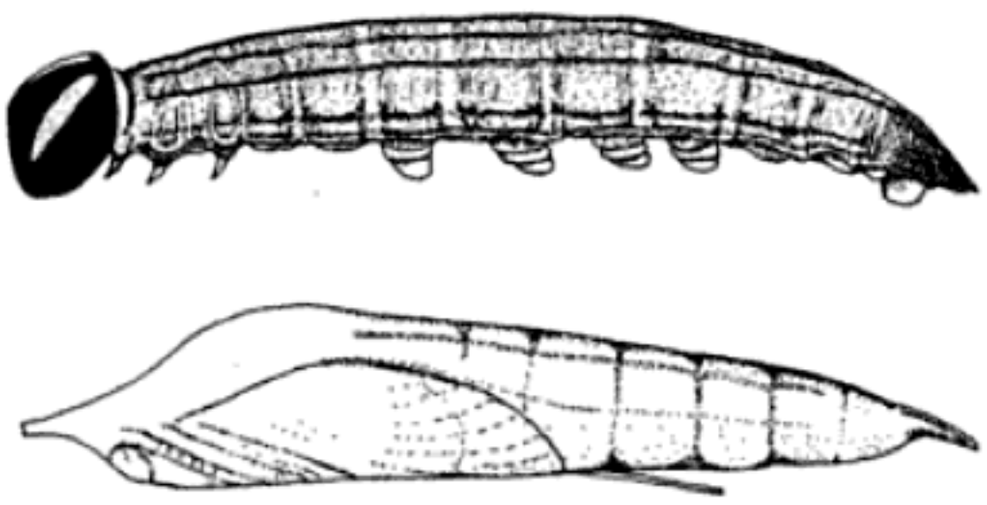
has a central notch. When the caterpillar is young, the head is pale with some additional white markings on the face, which later vanish. The last segment of the body is flattened and rounded.

The pupa is formed at the tip of the blade, on the hanging part and on the upper surface. Its head points towards the petiolar side. It is not enclosed in a cell, but only in a semi-circular channel, so it is easily visible. The walls of the channel (margins of the blade) are held together by two or three strong silk bands. The pupa is pale green with thin, white, longitudinal lines on the upperside of the abdominal segments. It is broadest at the hump of the thorax, gradually decreasing in thickness at both the ends. The head has a long, conical projection in front. The last segment is flattened, curved slightly downwards and triangular. The proboscis reaches the end of the 10th segment, which is detached from the body of the pupa after the wing-cases.



Length of caterpillar: 32 mm. Length of pupa: 20 mm.

Larval Host Plants The caterpillars feed on various species of grasses. Annual, medium-sized grass species are preferred over tall, bunch-grass species. Among them, *Oryza* and *Setaria* are most commonly used and *O. sativa, S. glauca, S. pumila* are recorded. Other reported grasses are species of *Andropogon, Cymbopogon, Eragrostis, Ischaemum* and *Pennisetum*.

Economic Significance The Rice Swift is considered a minor pest of rice and its damage is insignificant compared to other crop pests such as stem- and root-borers. The caterpillars are not usually found in hordes and since they eat leaves, not reproductive parts, the production is affected to a smaller degree and only indirectly.

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Appendix 1: Larval Host Plants of Peninsular Indian Butterflies

1. This list gives larval host plants of all the peninsular Indian butterflies mentioned in this book in the species accounts. This excludes only those species for which host plants are not yet reported.
2. Only valid scientific names of plants are given. Synonyms could be found in the accompanying alphabetical list of these plants (Appendix 2).
3. In each butterfly species record, plant species, genera and families are arranged in alphabetical order for easy reference. The butterflies are arranged in their systematic order. Family designations of the plant species could be found in Appendix 2.

Family Papilionidae

1. Southern Birdwing (*Troides minos*): *Aristolochia indica, Aristolochia tagala, Thottea siliquosa* (Aristolochiaceae). p. 58.
2. Malabar Rose (*Pachliopta pandiyana*): *Thottea siliquosa* (Aristolochiaceae). p. 61.
3. Common Rose (*Pachliopta aristolochiae*): *Aristolochia bracteolata, Aristolochia indica, Aristolochia tagala, Thottea siliquosa* (Aristolochiaceae). p. 60.
4. Crimson Rose (*Pachliopta hector*): *Aristolochia indica, Thottea siliquosa* (Aristolochiaceae). p. 62.
5. Common Bluebottle (*Graphium sarpedon*): *Alseodaphne semicarpifolia, Cinnamomum camphora, Cinnamomum macrocarpum, Cinnamomum malabatrum, Litsea chinensis, Persea macrantha, Miliusa tomentosum, Polyalthia longifolia* (Annonaceae, Lauraceae, Magnoliaceae). p. 63.
6. Common Jay (*Graphium doson*): *Annona lawii, Cinnamomum macrocarpum, Magnolia grandiflora, Michelia champaca, Miliusa tomentosum, Polyalthia longifolia,* (Annonaceae, Lauraceae, Magnoliaceae). p. 64.
7. Tailed Jay (*Graphium agamemnon*): *Annona discolor, Annona muriacata, Annona reticulata, Annona squamosa, Artabotrys hexapetalus, Cinnamomum* spp., *Michelia champaca, Miliusa tomentosum, Polyalthia cerasoides, Polyalthia longifolia* (Annonaceae, Lauraceae, Magnoliaceae). p. 66.
8. Spot Swordtail (*Graphium nomius*): *Miliusa tomentosum, Miliusa velutina, Polyalthia longifolia* (Annonaceae). p. 68.
9. Five-bar Swordtail (*Graphium antiphates*): *Annona elegance, Annona lawii, Annona zeylanica, Miliusa* sp., *Uvaria* sp. (Annonaceae, Magnoliaceae). p. 68.
10. Common Mime (*Papilio clytia*): *Alseodaphne semicarpifolia, Cinnamomum camphora, Cinnamomum macrocarpum, Litsea chinensis, Litsea deccanensis* (Lauraceae). p. 70.
11. Lime (*Papilio demoleus*): *Aegle marmelos, Chloroxylon swietenia, Citrus aurantifolia, Citrus grandis, Citrus limon, Citrus sinensis, Glycosmis arborea, Murraya koenigii, Ruta graveolens* (Rutaceae). p. 71.
12. Malabar Banded Swallowtail (*Papilio liomedon*): *Acronychia pedunculata, Evodia roxburghiana* (Rutaceae). p. 73.
13. Malabar Raven (*Papilio dravidarum*): *Glycosmis arborea* (Rutaceae). p. 150.
14. Red Helen (*Papilio helenus*): *Citrus limon, Clausena heptaphylla, Evodia* sp., *Glycosmis arborea, Phellodendron* sp., *Toddalia asiatica, Zanthoxylum rhetsa* (Rutaceae). p. 73.
15. Common Mormon (*Papilio polytes*): *Atalantia racemosa, Aegle marmelos, Citrus aurantifolia, Citrus grandis, Citrus limon, Citrus medica, Citrus sinensis, Glycosmis arborea, Murraya koenigii, Murraya paniculata, Tripahsia* sp., *Zanthoxylum rhetsa* (Rutaceae). p. 73.
16. Blue Mormon (*Papilio polymnestor*): *Atalantia racemosa, Atalantia wightii, Citrus grandis, Citrus limon, Glycosmis arborea, Paramigyna monophylla* (Rutaceae). p. 76.

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17. Paris Peacock (*Papilio paris*): *Citrus* sp., *Evodia roxburghiana, Toddalia asiatica, Zanthoxylum ovalifolium* (Rutaceae). p. 77.
18. Common Banded Peacock (*Papilio crino*): *Chloroxylon swietenia* (Rutaceae). p. 77.
19. Malabar Banded Peacock (*Papilio buddha*): *Zanthoxylum rhetsa* (Rutaceae). p. 78.

Family Pieridae

20. Common Emigrant (*Catopsilia pomona*): *Bauhinia racemosa, Butea monosperma, Cassia fistula, Cassia siamea, Cassia tora* (Caesalpiniaceae, Fabaceae). p. 85.
21. Mottled Emigrant (*Catopsilia pyranthe*): *Cassia auriculata, Cassia fistula, Cassia occidentalis, Cassia tora, Gnidia glauca, Sesbania bispinosa* (Caesalpiniaceae, Thymelaeaceae). p. 87.
22. Small Grass Yellow (*Eurema brigitta*): *Cassia kleinii* (Caesalpiniaceae). p. 89.
23. Spotless Grass Yellow (*Eurema laeta*): Leguminous plants. p. 89.
24. Common Grass Yellow (*Eurema hecabe*): *Acacia* spp., *Albizia* spp., *Caesalpinia* spp., *Cassia fistula, Cassia obtusifolia, Cassia tora, Moulluva spicata, Pithecellobium dulce, Sesbania bispinosa* (Caesalpiniaceae, Fabaceae, Mimosaceae). p. 89.
25. Three-spot Grass Yellow (*Eurema blanda*): *Albizia* spp., *Cassia fistula, Delonix regia, Moulluva spicata, Pithecellobium dulce* (Caesalpiniaceae, Fabaceae, Mimosaceae). p. 89.
26. Nilgiri Clouded Yellow (*Colias nilagiriensis*): *Parochetus communis* (Fabaceae). p. 91.
27. Common Jezebel (*Delias eucharis*): *Dendrophthoe falcata, Helicanthes elastica, Scurrula parasitica, Viscum* spp. (Loranthaceae). p. 93.
28. Painted Sawtooth (*Prioneris sita*): *Capparis tenera, Capparis zeylanica* (Capparaceae). p. 93.
29. Psyche (*Leptosia nina*): *Capparis rheedii, Capparis spinosa, Capparis zeylanica, Cleome viscosa, Crateva adansonii* (Capparaceae). p. 94.
30. Indian Cabbage White (*Pieris canidia*): *Brassica oleracea* (cabbage), *Rorippa dubia, Sisymbrium* sp. (Brassicaceae). p. 95.
31. Common Gull (*Cepora nerissa*): *Cadaba fruticosa, Capparis decidua, Capparis rheedii, Capparis sepiaria, Capparis zeylanica, Maerua oblongifolia* (Capparaceae). p. 97.
32. Lesser Gull (*Cepora nadina*): *Capparis cleghornii, Capparis moonii, Capparis rheedii* (Capparaceae). p. 97.
33. Pioneer (*Anaphaeis aurota*): *Cadaba fruticosa, Capparis decidua, Capparis pyrifolia, Capparis rheedii, Capparis sepiaria, Capparis spinosa, Capparis zeylanica, Maerua oblongifolia* (Capparaceae). p. 99.
34. Common Albatross (*Appias albina*): *Drypetes oblongifolia, Drypetes roxburghii, Drypetes venusta* (Euphorbiaceae). p. 100.
35. Plain Puffin (*Appias indra*): *Drypetes oblongifolia, Drypetes roxburghii* (Euphorbiaceae). p. 101.
36. Striped Albatross (*Appias libythea*): *Capparis cleghornii, Capparis sepiaria, Capparis zeylanica, Crateva adansonii* (Capparaceae). p. 101.
37. Chocolate Albatross (*Appias lyncida*): *Capparis cleghornii, Crateva adansonii,* (Capparaceae). p. 101.
38. Lesser Albatross (*Appias wardii*): *Capparis rheedii, Drypetes venusta* (Capparaceae, Euphorbiaceae). p. 101.
39. Small Orange Tip (*Colotis etrida*): *Cadaba fruticosa, Maerua oblongifolia* (Capparaceae). p. 103.
40. Plain Orange Tip (*Colotis eucharis*): *Cadaba fruticosa* (Capparaceae). p. 103.
41. Crimson Tip (*Colotis danae*): *Cadaba fruticosa, Capparis divaricata, Capparis sepiaria, Maerua oblongifolia* (Capparaceae). p. 103.
42. White Orange Tip (*Ixias marianne*): *Capparis decidua, Capparis divaricata,*

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Capparis grandis, Capparis sepiaria (Capparaceae). p. 103.

43. Yellow Orange Tip (*Ixias pyrene*): *Capparis sepiaria* (Capparaceae). p. 103.
44. Great Orange Tip (*Hebomoia glaucippe*): *Capparis moonii, Capparis spinosa, Crateva adansonii* (Capparaceae). p. 103.
45. Common Wanderer (*Pareronia valeria*): *Capparis rheedii, Capparis zeylanica* (Capparaceae). p. 105.
46. Dark Wanderer (*Pareronia ceylonica*): *Capparis rheedii* (Capparaceae). p. 105.

Family Nymphalidae

47. Common Evening Brown (*Melanitis leda*): *Apluda* spp., *Cyrtococcum* spp., *Eleusine* spp., *Oplismenus compositus, Oryza sativa, Panicum* spp., *Sorghum* spp., *Zea* spp., (Poaceae). p. 112.
48. Great Evening Brown (*Melanitis zitenius*): Bamboo (Poaceae). p. 112.
49. Dark Evening Brown (*Melanitis phedima*): *Apluda* spp., *Cyrtococcum* spp., *Eleusine* spp., *Oplismenus compositus, Oryza sativa, Panicum* spp., *Sorghum* spp., *Zea* spp. (Poaceae). p. 112.
50. Common Palmfly (*Elymnias hypermenstra*): *Areca catechu, Arenga wightii, Calamus* spp., *Cocos nucifera, Phoenix* spp. (Arecaceae). p. 146.
51. Whitebar Bushbrown (*Mycalesis anaxias*): *Oplismenus compositus* (Poaceae). p. 114.
52. Common Bushbrown (*Mycalesis perseus*): *Oryza* spp., *Oplismenus compositus* (Poaceae). p. 114.
53. Dark-Brand Bushbrown (*Mycalesis mineus*): Grasses (Poaceae). p. 115.
54. Gladeye Bushbrown (*Mycalesis patnia*): *Oryza* spp. (Poaceae). p. 114.
55. Redeye Bushbrown (*Mycalesis adolphei*): Grasses (Poaceae). p. 115.
56. Nigger (*Orsotrioena medus*): *Imperata* sp., *Oryza sativa* (Poaceae). p. 115.
57. Common Three-ring (*Ypthima asterope*): Grasses (Poaceae). p. 117.
58. Common Four-ring (*Ypthima huebneri*): Grasses (Poaceae). p. 117.
59. Common Five-ring (*Ypthima baldus*): Grasses (Poaceae). p. 116.
60. Nilgiri Four-ring (*Ypthima chenui*): Grasses (Poaceae). p. 117.
61. Tawny Coster (*Acraea violae*): *Adenia hondala, Passiflora edulis, Passiflora foetida, Passiflora subpeltata* (Passifloraceae). p. 118.
62. Tamil Lacewing (*Cethosia nietneri*): *Adenia hondala, Passiflora edulis, Passiflora subpeltata* (Passifloraceae). p. 119.
63. Cruiser (*Vindula erota*): *Adenia hondala* (Passifloraceae). p. 122.
64. Rustic (*Cupha erymanthis*): *Flacourtia indica, Flacourtia montana* (Flacourtiaceae). p. 121.
65. Common Leopard (*Phalanta phalantha*): *Flacourtia indica, Flacourtia montana, Salix* sp., *Smilax* sp., *Xylosma longifolium* (Flacourtiaceae, Salicaceae, Smilacaceae). p. 122.
66. Small Leopard (*Phalanta alcippe*): *Rinorea bengalensis* (Violaceae). p. 122.
67. Tamil Yeoman (*Cirrochroa thais*): *Hydnocarpus pentandra* (Flacourtiaceae). p. 122.
68. Indian Fritillary (*Argyreus hyperbius*): *Viola* spp. (Violaceae). p. 122.
69. Black Prince (*Rohana parisatis*): *Celtis tetrandra* (Ulmaceae). p. 134.
70. Chestnut-streaked Sailer (*Neptis jumbah*): *Bombax ceiba, Byttneria* sp., *Dalbergia* sp., *Elaeocarpus* sp., *Grewia* sp., *Hibiscus* sp., *Moulluva spicata, Pongamia pinnata, Thespesia populnea, Xylia xylocarpa, Ziziphus* sp. (Bombacaceae, Caesalpiniaceae, Elaeocarpaceae, Fabaceae, Malvaceae, Mimosaceae, Rhamnaceae, Sterculiaceae, Tiliaceae). p. 125.
71. Common Sailer (*Neptis hylas*): *Bombax ceiba, Canavalia gladiata, Corchorus* sp., *Flemingia* sp., *Grewia* sp., *Helicteres isora, Lathyrus* sp., *Mucuna purpurea, Nothapodytes nimmoniana, Paracalyx scariosa, Triumfetta* sp., *Vigna cylindrica, Vigna unguiculata, Xylia xylocarpa* (Bombacaceae, Fabaceae,

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Icacinaceae, Mimosaceae, Sterculiaceae, Tiliaceae). p. 124.

72. Shortbanded Sailer (*Neptis columella*): *Dalbergia* sp. (Fabaceae). p. 125.
73. Blackvein Sergeant (Athyma ranga): *Chionanthus mala-elengi, Olea dioica* (Oleaceae). p. 125.
74. Common Sergeant (*Athyma perius*): *Glochidion lanceolarum, Glochidion velutinum, Phyllanthus* sp. (Euphorbiaceae). p. 125.
75. Commander (*Limenitis procris*): *Cadaba fruticosa, Hedyotis orixense, Mitragyna parvifolia, Mussaenda frondosa, Neolamarckia cadamba, Ochreinauclea missionis, Wendlandia exserta, Wendlandia thyrsoidea* (Capparaceae, Rubiaceae). p. 127.
76. Clipper (*Parthenos sylvia*): *Adenia hondala, Tinospora cordifolia* (Menispermaceae, Passifloraceae). p. 128.
77. Grey Count (*Tanaecia lepidea*): *Careya arborea, Melastoma malabathricum* (Lecythidaceae, Melastomaceae). p. 129.
78. Common Baron (*Euthalia aconthea*): *Anacardium occidentale, Bryonia* sp., *Mangifera indica, Morus* sp., *Rosa* sp., *Scurrula parasitica, Streblus asper* (Anacardiaceae, Cucurbitaceae, Loranthaceae, Moraceae, Rosaceae). p. 130.
79. Baronet (*Euthalia nais*): *Diospyros melanoxylon, Shorea robusta* (Dipterocarpaceae, Ebenaceae). p. 122.
80. Redspot Duke (*Dolpha evelina*): *Anacardium occidentale, Diospyros candolleana, Diospyros melanoxylon* (Anacardiaceae, Ebenaceae). p. 131.
81. Angled Castor (*Ariadne ariadne*): *Ricinus communis, Tragia involucrata, Tragia plukenetii* (Euphorbiaceae). p. 133.
82. Common Castor (*Ariadne merione*): *Ricinus communis, Tragia involucrata, Tragia plukenetii* (Euphorbiaceae). p. 134.
83. Yellow Pansy (*Junonia hierta*): *Barleria* spp., *Hygrophila auriculata* (Acanthaceae). p. 137.
84. Blue Pansy (*Junonia orithya*): *Acanthus* sp., *Antirrhinum orontium, Barleria* sp., *Hygrophila auriculata, Justicia neesii, Justicia procumbens, Lepidagathis prostrata* (Acanthaceae). p. 136.
85. Lemon Pansy (*Junonia lemonias*): *Barleria* sp., *Cannabis sativa, Corchorus capsularis, Hygrophila auriculata, Nelsonia canescens, Sida rhombifolia* (Acanthaceae, Malvaceae, Tiliaceae). p. 136.
86. Peacock Pansy (*Junonia almana*): *Acanthus* sp., *Barleria* sp., *Gloxinia* sp., *Hygrophila auriculata, Phyla nodiflora* (Acanthaceae, Gesneriaceae, Verbenaceae). p. 136.
87. Grey Pansy (*Junonia atlites*): *Barleria* sp., *Hygrophila auriculata* (Acanthaceae). p. 136.
88. Chocolate Pansy (*Junonia iphita*): *Hygrophila auriculata, Justicia neesii, Carvia callosa* (Acanthaceae). p. 137.
89. Painted Lady (*Cynthia cardui*): *Artemisia* sp., *Blumea* sp., *Debregeasia bicolor, Gnaphalium* sp., *Tricholepis* sp., *Zornia gibbosa* (Asteraceae, Fabaceae, Urticaceae). p. 138.
90. Indian Red Admiral (*Vanessa indica*): *Girardinia diversifolia, Urtica* sp. (Urticaceae). p. 139.
91. Great Eggfly (*Hypolimnas bolina*): *Laportae interrupta, Portulaca oleracea, Sida rhombifolia* (Malvaceae, Portulacaceae, Urticaceae). p. 141.
92. Danaid Eggfly (*Hypolimnas misippus*): *Abelmoschus* sp., *Abutilon* sp., *Asystasia lawiana, Barleria cristata, Hibiscus* sp., *Portulaca oleracea* (Acanthaceae, Malvaceae, Portulacaceae). p. 141.
93. Glassy Tiger (*Parantica aglea*): *Calotropis gigantea, Ceropegia bulbosa, Cryptolepis buchanani, Tylophora indica, Tylophora tenuis* (Asclepiadaceae). p. 143.
94. Blue Tiger (*Tirumala linniace*): *Asclepias curassavica, Calotropis gigantea, Hoya* sp., *Tylophora indica, Wattakaka volubilis* (Asclepiadaceae). p. 143.
95. Dark Blue Tiger (*Tirumala septentrionis*): *Vallaris heynei, Wattakaka volubilis* (Apocynaceae, Asclepiadaceae). p. 143.
96. Plain Tiger (*Danaus chrysippus*): *Asclepias curassavica, Calotropis gigantea,*

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Cryptolepis buchnani (Asclepiadaceae). p. 145.

97. Striped Tiger (*Danaus genutia*): *Asclepias curassavica, Ceropegia intermedia, Stephanotis* sp., *Tylophora tenuis* (Asclepiadaceae). p. 148.
98. Common Indian Crow (*Euploea core*): *Cryptolepis buchanani, Cryptolepis elegans, Ficus benghalensis, Ficus racemosa, Ficus religiosa, Hemidesmus indicus, Holarrhena pubescens, Ichnocarpus frutescens, Nerium odorum, Nerium oleander, Streblus asper, Tylophora indica* (Apocynaceae, Asclepiadaceae, Moraceae). p. 149.
99. Double-branded Crow (*Euploea sylvester*): *Ficus* spp., *Ichnocarpus frutescens* (Apocynaceae, Moraceae). p. 149.
100. Brown King Crow (*Euploea klugii*): *Ficus hispida, Streblus asper* (Moraceae). p. 149.
101. Malabar Tree Nymph (*Idea malabarica*): *Aganosma cymosa* (Apocynaceae). p. 152.

Family Lycaenidae

102. Common Pierrot (*Castalius rosimon*): *Ziziphus mauritiana, Ziziphus rugosa* (Rhamnaceae). p. 159.
103. Angled Pierrot (*Caleta caleta*): *Ziziphus rugosa* (Rhamnaceae). p. 160.
104. Banded Blue Pierrot (Discolampa ethion): *Ziziphus mauritiana, Ziziphus oenoplia, Ziziphus xylopyrus* (Rhamnaceae). p. 160.
105. Dark Pierrot (*Tarucus ananda*): *Dendrophthoe falcata* (?), *Ziziphus xylopyrus* (Loranthaceae (?), Rhamnaceae). p. 160.
106. Rounded Pierrot (*Tarucus nara*): *Ziziphus mauritiana* (Rhamnaceae). p. 160.
107. Zebra Blue (*Leptotes plinius*): *Albizia lebbek, Dyerophytum indicum, Indigofera* sp., *Mimosa* sp., *Plumbago zeylanica, Sesbania bispinosa* (Fabaceae, Mimosaceae, Plumbaginaceae). p. 161.
108. Indian Cupid (*Everes lacturnus*): *Lotus corniculatus*? (Fabaceae). p. 169.
109. Common Hedge Blue (*Actolepis puspa*): *Paracalyx scariosa, Schliechera oleosa, Xylia xylocarpa* (Fabaceae, Mimosaceae, Sapindaceae). p. 163.
110. Quaker (*Neopithecops zalmora*): *Glycosmis arborea* (Rutaceae). p. 164.
111. Malayan (*Magisba malaya*): *Allophylus cobbe, Erioglossum* sp., *Hemigyrosa* sp., *Schleichera oleosa* (Sapindaceae). p. 164.
112. Pale Grass Blue (*Psuedozizeeria maha*): *Nelsonia canescens, Oxalis corniculata, Strobilanthes* spp., *Tephrosia pauciflora* (Acanthaceae, Fabaceae, Oxalidaceae). p. 166.
113. Dark Grass Blue (*Zizeeria karsandra*): *Amaranthus viridis, Zornia gibbosa* (Amaranthaceae, Fabaceae). p. 166.
114. Lesser Grass Blue (*Zizina otis*): *Alysicarpus vaginalis, Sesbania bispinosa, Zornia gibbosa* (Fabaceae). p. 166.
115. Tiny Grass Blue (*Zizula hylax*): *Hygrophila auriculata, Lantana camara, Nelsonia canescens, Phaulopsis dorsiflora, Strobilanthes* spp., *Vicia* spp. (Acanthaceae, Fabaceae, Verbenaceae). p. 165.
116. Lime Blue (*Chilades laius*): *Acacia* spp., *Atalantia racemosa, Atalantia wightii, Citrus limon, Citrus sinensis, Naringi crenulata* (Rutaceae). p. 167.
117. Plains Cupid (*Chilades pandava*): *Acacia* spp., *Caesalpinia* sp., *Cycas revoluta, Xylia xylocarpa* (Caesalpiniaceae, Cycadaceae, Mimosaceae). p. 169.
118. Grass Jewel (*Freyeria trochylus*): *Goniogyna hirta, Indigofera* sp., *Lotus corniculatus, Oxalis corniculata, Pisum sativum, Rhynchosia minima, Vicia* sp. (Fabaceae, Oxalidaceae). p. 166.
119. Gram Blue (*Euchrysops cnejus*): *Acacia* spp., *Butea monosperma, Paracalyx scariosa, Ougeinia oojeinensis, Pisum sativum, Vigna cylindrica, Vigna trilobata*, various grams and beans (Fabaceae, Mimosaceae). p. 169.
120. Forget-me-not (*Catochrysops strabo*): *Desmodium* sp., *Ougeinia oojeinensis, Paracalyx scariosa, Schleichera oleosa* (Fabaceae, Sapindaceae). p. 169.
121. Pea Blue (*Lampides boeticus*): *Butea monosperma, Crotalaria* spp., *Pisum*

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sativum, Vigna sinensis, species of gram (Fabaceae). p. 170.

122. Dark Cerulean (*Jamides bochus*): *Butea monosperma, Crotalaria* sp., *Millettia peguensis, Pongamia pinnata, Tephrosia candida, Vigna cylindrica, Xylia xylocarpa* (Fabaceae, Mimosaceae). p. 172.
123. Common Cerulean (*Jamides celeno*): *Abrus precatorius, Butea monosperma, Elettaria cardamomum, Pongamia pinnata, Saraca asoca, Trichilia connaroides, Xylia xylocarpa* (Caesalpiniaceae, Fabaceae, Meliaceae, Mimosaceae, Zingiberaceae). p. 172.
124. Metallic Cerulean (*Jamides alecto*): *Elettaria cardamomum* (Zingiberaceae). p. 172.
125. Common Lineblue (*Prosotas nora*): *Acacia catechu, Acacia torta, Pithecellobium dulce* (Mimosaceae), and a few unspecified plants from families Combretaceae, Myrtaceae and Sapindaceae. p. 174.
126. Red Pierrot (*Talicada nyseus*): *Kalanchoe laciniata, Kalanchoe pinnata* (Crassulaceae). p. 176.
127. Leaf Blue (*Horsfieldia anita*): *Olax imbricata, Olax scandens* (Olacaceae). p. 179.
128. Western Centaur Oakblue (*Arhopala psuedocentaurus*): *Lagerstroemia microcarpa, Schleichera oleosa, Terminalia alata, Terminalia paniculata, Xylia xylocarpa* (Combretaceae, Lythraceae, Mimosaceae, Sapindaceae). p. 178.
129. Large Oakblue (*Arhopala amantes*): *Lagerstroemia microcarpa, Lagerstroemia reginae, Terminalia catappa, Terminalia alata, Terminalia paniculata, Xylia xylocarpa* (Combretaceae, Lythraceae, Mimosaceae). p. 178.
130. Manytailed Oakblue (*Thaduka multicaudata*): *Trewia nudiflora* (Euphorbiaceae). p. 179.
131. Silverstreak Blue (*Iraota timoleon*): *Ficus benghalensis, Ficus racemosa, Ficus religiosa, Punica granatum* (Lythraceae, Moraceae). p. 179.
132. Common Silverline (*Spindasis vulcanus*): *Allophylus cobbe, Cadaba fruticosa, Canthium coromandelicum, Clerodendrum indicum, Ziziphus mauritiana, Ziziphus rugosa* (Capparaceae, Rhamnaceae, Rubiaceae, Sapindaceae, Verbenaceae). p. 180.
133. Long-banded Silverline (*Spindasis lohita*): *Dioscorea pentaphylla, Terminalia paniculata, Xylia xylocarpa* (Combretaceae, Dioscoriaceae, Mimosaceae). p. 181.
134. Peacock Royal (*Tajuria cippus*): *Dendrophthoe falcata, Helicanthus elastica, Helixanthera wallichiana* (Loranthaceae). p. 183.
135. Indian Red Flash (*Rapala iarbus*): *Litchi* sp., *Ougeinia oojeinensis, Ziziphus rugosa* (Fabaceae, Rhamnaceae, Sapindaceae). p. 185.
136. Slate Flash (*Rapala manea*): *Acacia megaladena, Acacia pennata, Acacia torta, Antidesma acidum, Antidesma ghaesembilla, Camelia sinensis, Quisqualis indica, Sorbaria sorbifolia, Ziziphus* sp. (Combretaceae, Euphorbiaceae, Mimosaceae, Rhamnaceae, Rosaceae, Theaceae). p. 185.
137. Indigo Flash (*Rapala varuna*): *Lantana camara, Quisqualis indica, Sapindus laurifolia, Ziziphus rugosa, Ziziphus xylopyrus* (Combretaceae, Rhamnaceae, Sapindaceae, Verbenaceae). p. 185.

Family Hesperiidae

138. Common Banded Awl (*Hasora chromus*): *Pongamia pinnata, Ricinus communis, Trichilia connaroides* (Fabaceae, Euphorbiaceae, Meliaceae). p. 191.
139. White Banded Awl (*Hasora taminatus*): *Brachypterum scandens* (Fabaceae). p. 192.
140. Common Awl (*Hasora badra*): *Derris uliginosa* (Fabaceae). p. 192.
141. Plain Banded Awl (*Hasora vitta*): *Millettia extensa, Millettia pallida* (Fabaceae). p. 192.
142. Brown Awl (*Badamia exclamationis*): *Combretum albidum, Combretum latifolium, Terminalia bellirica* (Combretaceae). p. 194.

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143. Common Spotted Flat (*Celaenorrhinus leucocera*): *Asystasia gangetica, Carvia callosa, Ecbolium ligustrinum, Eranthemum roseum, Thelepaepale ixiocephala* (Acanthaceae). p. 196.
144. Malabar Spotted Flat (*Celaenorrhinus ambareesa*): *Carvia callosa, Daedalacanthus purpurascens, Eranthemum roseum* (Acanthaceae). p. 196.
145. Tamil Spotted Flat (*Celaenorrhinus ruficornis*): *Carvia callosa* (Acanthaceae). p. 196.
146. Common Snow Flat (*Tagiades japetus*): *Dioscorea oppositifolia* (Dioscoraceae). p. 198.
147. Suffused Snow Flat (*Tagiades gana*): *Dioscorea oppositifolia* (Dioscoraceae). p. 198.
148. Water Snow Flat (*Tagiades litigiosa*): *Dioscorea oppositifolia, Smilax* spp. (Dioscoraceae, Smilacaceae). p. 198.
149. Fulvous Pied Flat (*Psuedocoladenia dan*): *Achyranthes aspera* (Amaranthaceae). p. 200.
150. Common Small Flat (*Sarangesa dasahara*): *Asystasia* spp., *Blepharis asperrima* (Acanthaceae). p. 202.
151. Spotted Small Flat (*Sarangesa purendra*): *Asystasia* spp. (Acanthaceae). p. 202.
152. Golden Angle (*Odontoptilum ransonetti*): *Helicteres isora* (Sterculiaceae). p. 201.
153. Chestnut Angle (*Odontoptilum angulata*): *Allophylus cobbe, Ceiba pentandra, Hibiscus tiliaceus, Urena lobata* (Bombacaceae, Malvaceae, Sapindaceae). p. 201.
154. African Marbled Skipper (Gomalia elma): *Abutilon indicum* (Malvaceae). p. 204.
155. Indian Skipper (*Spialia galba*): *Hibiscus* sp., *Sida rhombifolia, Waltheria indica* (Malvaceae, Sterculiaceae). p. 203.
156. Indian Ace (*Halpe homolea*): Bamboos (Poaceae). p. 219.
157. Madras Ace (*Thoressa honorei*): Bamboos (Poaceae). p. 219.
158. Chestnut Bob (*Iambrix salsala*): *Bambusa arundinaceae* and grasses (Poaceae). p. 205.
159. Coon (*Psolos fuligo*): *Stachyphrynium spicatum* (Marantaceae). p. 206.
160. Common Banded Demon (*Notocrypta paralysos*): *Curcuma* spp., *Zingiber* spp. (Zingiberaceae). p. 207.
161. Restricted Demon (*Notocrypta curvifascia*): *Costus speciosus, Curcuma decipiens, Hedychium*(?), *Kaempferia rotunda, Zingiber montanum* (Zingiberaceae). p. 207.
162. Grass Demon (*Udaspes folus*): *Curcuma aromatica, Curcuma decipiens, Hedychium* spp., *Zingiber* spp. (Zingiberaceae). p. 208.
163. Indian Palm Bob (*Suastus gremius*): *Calamus* spp., *Caryota urens, Cocos nucifera, Phoenix acaulis, Phoenix lourierii* (Arecaceae). p. 211.
164. Giant Redeye (*Gangara thyrsis*): *Calamus rotang, Caryota urens, Cocos nucifera, Licuala grandis, Phoenix acaulis, Phoenix lourierii* (Arecaceae). p. 213.
165. Palm Redeye (*Erionota thrax*): *Cocos nucifera, Musa sapientium, Saccharum* sp. (Arecaceae, Musaceae, Poaceae). p. 213.
166. Common Redeye (*Matapa aria*): *Bambusa arundinacea* (Poaceae). p. 213.
167. Common Grass Dart (*Taractrocera maevius*): Grasses (Poaceae). p. 216.
168. Tamil Grass Dart (*Taractrocera ceramas*): *Oryza sativa* and other grasses (Poaceae) p. 215.
169. Pale Palm Dart (*Telicota colon*): Bamboos, *Oryza* spp., *Saccharum* spp. (Poaceae). p. 217.
170. Dark Palm Dart (*Telicota ancilla*): Bamboos, *Oryza* spp., *Saccharum* spp. (Poaceae). p. 217.
171. Rice Swift (*Borbo cinnara*): *Andropogon* sp., *Cymbopogon* sp., *Eragrostis* sp., *Ischaemum* sp., *Oryza sativa, Pennisetum* sp., *Setaria glauca, Setaria pumila* (Poaceae). p. 218.
172. Bevan's Swift (*Borbo bevani*): *Imperata cylindrica, Paspalum conjugatum, Saccharum* spp. (Poaceae). p. 219.
173. Conjoined Swift (*Pelopidas conjucta*): Bamboos and grasses (Poaceae). p. 219

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Appendix 2: Alphabetical List of Larval Host Plants and Nectar Plants

1. This is an alphabetical list of plants that are used as larval host plants or adult food ('nectar') plants by butterflies of peninsular India. Every entry for a plant species in this list follows the order: the plant's Current scientific name (= Synonyms; Family): Growth form, Habitat, Relevant notes. The plants were assigned to growth forms; namely, herb, shrub, climber and tree (small or large). Trees are 'large' or 'small' depending on their relative heights within a vegetation type in which they occur, and this applies to tall evergreen as well as deciduous forest species. Bamboos are gigantic grasses, and plants of family Loranthaceae are plant parasites that hang from branches of trees. However, in the list below I mention them as, respectively, large trees and shrubs or herbs, because their growth forms fit in these two categories. This is botanically incorrect, but bamboos as trees and plant parasites as hanging shrubs, is probably how butterflies and other insects look at them in terms of amount of foliage available on a single plant. So from their viewpoint this assignment may be correct.
2. Certain plant synonyms which were frequently mentioned in old literature on this subject are separately entered in this list. These separate entries for the synonyms are marked by bullets, valid names are numbered.
3. An '**A**' at the end of species entries indicates that those plants are used only as nectar plants, '**LA**' indicates that the plants are used as both larval host plants and nectar plants. All the other plants in the list are used only as larval host plants.

1. *Abelmoschus* (Malvaceae): herbs in the secondary semi-evergreen and deciduous forests.
2. *Abrus precatorius* (Fabaceae): climber in the deciduous forests and scrublands.
3. *Abutilon indicum* (Malvaceae): herb in slightly disturbed places in dry deciduous forests, scrublands and habitations. **LA**.
4. *Acacia megaladena* (=*Acacia arrophula, Acacia pennata* var. *arrophula*; Mimosaceae): straggling shrub in the deciduous forests.
5. *Acacia pennata* (=*Mimosa pennata*; Mimosaceae): large climbing shrub in the dry deciduous forest and scrublands.
6. *Acacia torta* (=*Acacia caesia, Acacia intsia, Mimosa caesia, Mimosa torta*; Mimosaceae): straggling shrub in the deciduous forests.
7. *Acanthus* (Acanthaceae): shrubs in salty marshes.
8. *Achyranthes aspera* (Amaranthaceae): herb in the dry deciduous forest, scrublands and habitations.
9. *Acronychia pedunculata* (=*Acronychia laurifolia, Jambolifera pedunculata*; Rutaceae): small tree in the evergreen forest.
10. *Adelocaryum* (Boraginaceae): herbs at the edges of evergreen and semi-evergreen forests. **A**.
11. *Adenia hondala* (=*Adenia palmata, Granadilla hondala, Modecca palmata*; Passifloraceae): large climber in moist deciduous to evergreen forests.
12. *Aegle marmelos* (Rutaceae): large tree in the deciduous forests and habitations.
13. *Aganosma cymosa* (=*Echites cymosa*; Apocynaceae): climber in the deciduous forests.
14. *Ageratum* (Asteraceae): herb in disturbed places. **A**.
15. *Albizia lebbek* (=*Mimosa lebbeck*; Mimosaceae): large tree in the dry deciduous forests and planted as an avenue tree.
16. *Allophylus cobbe* (=*Allophylus rheedii, Rhus cobbe, Schmidelia rheedii*; Sapindaceae): shrub in the deciduous forests.
17. *Alseodaphne semicarpifolia* (Lauraceae): large tree in the semi-evergreen and evergreen forests.

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- *Alsodeia zeylanica*: see *Rinorea bengalensis*.

18. *Alternanthera* (Amaranthaceae): small, trailing herbs in disturbed areas around human habitations. **A.**
19. *Alysicarpus vaginalis* (=*Hedysarum vaginalis*; Fabaceae): herb on wet grassy slopes in deciduous forests.
20. *Amaranthus viridis* (=*Amaranthus fasciatus, Amaranthus gracilis*; Amaranthaceae): herbs in disturbed places and human habitations.
21. *Andrographis* (Acanthaceae): small shrubs in deciduous and semi-evergreen forests, and large openings in evergreen forests. **A.**
22. *Anacardium occidentale* (Anacardiaceae): large tree in the plantations, introduced in the country.
23. *Annona elegance* (Annonaceae): an exotic small tree.
24. *Annona lawii* (Annonaceae): an exotic small tree.
25. *Annona reticulata* (Annonaceae): "Custard Apple": small tree, native of C. America and W. Indies, cultivated and often naturalised, up to 1200 m.
26. *Annona squamosa* (Annonaceae): "Custard Apple": small tree, native of C. America and W. Indies, cultivated and often naturalised, up to 1200 m.
27. *Annona zeylanica* (Annonaceae): an exotic small tree.

- *Anthocephalus cadamba*: see *Neolamarckia cadamba*.

28. *Antidesma acidum* (=*Antidesma diandrum, Antidesma lanceolarium, Stilago diandra*; Euphorbiaceae): shrub in the deciduous forests in the plains.
29. *Antidesma ghaesembilla* (=*Antidesma pubescens*; Euphorbiaceae): small tree in the semi-evergreen forests.
30. *Apluda* (Poaceae): tall bushy grasses.
31. *Areca catechu* (Arecaceae): "areca or betel nut tree": large tree, cultivated mostly in coastal areas and Ghats.
32. *Arenga wightii* (Arecaceae): small tree along streamsides in the semi-evergreen and evergreen forests, also planted.
33. *Aristolochia bracteolata* (=*Aristolochia bracteata*, Aristolochiaceae): creeper in scrublands, savannahs and fallow fields.
34. *Aristolochia indica* (=*Aristolochia lanceolata*; Aristolochiaceae): climber-creeper in fallow fields.
35. *Aristolochia tagala* (=*Aristolochia acuminata, Aristolochia roxburghiana*; Aristolochiaceae): climbing shrub in the semi-evergreen forest at lower elevations.
36. *Artabotrys hexapetalus* (=*Annona hexapetala, Annona uncinata, Artabotrys odoratissimus, Artabotrys uncinatus, Uvaria odoratissima*; Annonaceae): shrub, often climbing, in the evergreen forests. Native of southern India, cultivated as well as naturalised throughout the country.
37. *Artemisia* (Asteraceae): shrubs in disturbed forests and grassland-savannahs.
38. *Asclepias curassavica* (Asclepiadaceae): herb in water-logged places in all habitats; native of the West Indies, now naturalised throughout peninsular India.

- *Asteracantha longifolia*: see *Hygrophila auriculata*.

39. *Asystasia gangetica* (=*Justicia gangetica*; Acanathaceae): bushy herb in the moist, shady deciduous forests, openings and rocky stream banks in semi-evergreen and evergreen forests. **LA.**
40. *Asystasia lawiana* (Acanathaceae): herb in the deciduous forests and neglected places in human habitations.
41. *Atalantia racemosa* (Rutaceae): small tree along the edges and stream banks in the evergreen forests.
42. *Atalantia wightii* (=*Atalantia ceylanica*; Rutaceae): shrub or small tree along the edges and stream banks in the evergreen forests.
43. Bamboos (Poaceae): generally large trees in the deciduous to evergreen forests.
44. *Bambusa arundinaceae* (=*Arundo bambos, Bambos arundinacea, Bambusa bambos*; Poaceae): large tree in deciduous forests; especially common on steep hill slopes and fire-afflicted areas.

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45. *Barleria* (Acanathaceae): shrubs in mostly evergreen and semi-evergreen forests, some species in deciduous forests and neglected places in human habitations.
46. *Bauhinia racemosa* (=*Piliostigma racemosa*; Caesalpiniacaeae): small tree in the deciduous forests, and cultivated in human habitations.
47. Beans (Fabaceae): herbs, many genera and species are cultivated.
48. *Bidens* (Asteraceae): herbs in open, disturbed places. **A.**
49. *Blepharis asperrima* (Acanathaceae): prostrate herb in the moist deciduous forest and shaded areas in the cultivated fields.
50. *Blepharistemma* (Rhizophoraceae): herbs and small shrubs in disturbed places. **A.**
51. *Blumea* (Asteraceae): herbs in open places at low and high altitudes under varying rainfall regimes.
52. *Boerhavia diffusa* (*Boerhavia procumbens*; Nyctaginaceae): herb in disturbed places in scrub, deicduous forests and around human habitations. **A.**
53. *Bombax ceiba* (=*Bombax malabaricum, Salmalia malabarica, Gossampinus malabaricus*; Bombacaceae): large tree in the deciduous forests; occasionally in evergreen forests and habitations.
54. *Brachypterum scandens* (=*Brachypterum timorensis, Dalbergia scandens, Dalbergia timorensis, Derris scandens, Derris timorensis*; Fabaceae): liana close to water in deciduous forests.
    - *Bragantia wallichii*: see *Thottea siliquosa*.
55. *Brassica oleracea* (Brassicaceae): "cabbage": herb, mostly cultivated.
56. *Bryonia* (Cucurbitaceae): climbers; species from the genus are now dissolved into many other genera.
    - *Bryophyllum calycinum*: see *Kalanchoe pinnata*.
57. *Buddleja* (Buddlejaceae): large shrubs and small trees in open areas, at the edges of forests, etc. **A.**
58. *Butea monosperma* (=*Butea frondosa, Erythrina monosperma, Plaso monosperma*; Fabaceae): small tree in the deciduous forests and habitations.
59. *Byttneria herbacea* (Sterculiaceae): creeping herb on dry sandy-rocky terrain.
60. *Cadaba fruticosa* (=*Cleome fruticosa, Cadaba indica*; Capparaceae): climbing shrub in scrublands.
61. *Caesalpinia* (Caesalpiniaceae): climbing shrubs or small trees in deciduous, semi-evergreen and evergreen forests; a few species used as ornamental plants. **LA.**
    - *Caesalpinia spicata*: see *Moulluva spicata*.
62. *Calamus rotang* (Arecaceae): climbing palm in the evergreen and shola forests.
63. *Calotropis gigantea* (=*Asclepias gigantea, Calotropis procera*; Asclepiadaceae): shrub in human habitations and close to water in scrub and grasslands. White flowered variety is '*gigantea*' and purple flowered is '*procera*'.
    - *Calotropis procera*: see *Calotropis gigantea*.
64. *Camelia sinensis* (=*Thea chinensis*; Theaceae): "Tea": shrub, native of China, extensively cultivated at mid- and high-elevations mainly in the southern Western Ghats and eastern Himalayas.
    - *Camphora officianalis*: see *Cinnamomum camphora*.
65. *Canavalia gladiata* (=*Canavalia ensiformis, Dolichos gladiatus*; Fabaceae): climbing shrub cultivated in the fields.
66. *Cannabis sativa* (=*Cannabina indica*; Cannabinacaeae): "Ganja": shrub, extensively cultivated in moist places in all habitats.
67. *Canthium coromandelicum* (=*Canthium parviflorum, Gmelina coromandelica, Plectronia parviflora*; Rubiaceae): small tree in the deciduous forests.
    - *Capparis aphylla*: see *Capparis decidua*.
68. *Capparis cleghornii* (=*Capparis roxburghii*; Capparaceae): shrub along edges of evergreen forests at mid-elevations, along laterite slopes in the Western Ghats.

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69. *Capparis decidua* (*Capparis aphylla, Sodada decidua*; Capparaceae): shrub or small tree in scrublands, up to 800 m.
70. *Capparis divaricata* (*Capparis stylosa*; Capparaceae): shrub or small tree in scrublands.
71. *Capparis grandis* (Capparaceae): small tree in scrublands, up to 1100 m.
    - *Capparis heyneana*: see *Capparis rheedii*.
    - *Capparis horrida*: see *Capparis zeylanica*.
72. *Capparis moonii* (Capparaceae): shrub along rocky slopes on laterite soil in moist deciduous and semi-evergreen forests, sea level to 1300 m.
73. *Capparis pyrifolia* (Capparaceae): shrub in scrublands.
74. *Capparis rheedii* (*Capparis heyneana, Capparis baducca*; Capparaceae): shrub in moist forests up to 700 m. on laterite soil, associated with *Capparis moonii*.
    - *Capparis roxburghii*: see *Capparis cleghornii*.
75. *Capparis sepiaria* (*Capparis incanescens, Capparis glauca*; Capparaceae): shrub in scrublands and deciduous forests, between 0–350 m.
76. *Capparis spinosa* (Capparaceae): shrub in scrublands and rocky cliffs.
77. *Capparis tenera* (Capparaceae): shrub in moderately high rainfall zones, up to 600 m.
78. *Capparis zeylanica* (=*Capparis horrida*; Capparaceae): climbing shrub in scrublands and deciduous forests, also neglected places in human habitations; between 300–600 m.
    - *Carduus*: the Thistle: see *Tricholepis*.
79. *Careya arborea* (Lecythidaceae): large tree in the deciduous forests, especially common in moist areas and fire-afflicted sites.
80. *Carvia callosa* (=*Strobilanthes callosus*; Acanthaceae): shrub in moist deciduous and semi-evergreen forests, edges of evergreen forests; growing gregariously especially on rocky areas and slopes.
81. *Caryota urens* (Arecaceae): large palm in the semi-evergreen forests with high rainfall.
82. *Cassia auriculata* (Caesalpiniacaeae): shrub in scrub savannahs and habitations.
83. *Cassia fistula* (=*Cassia rhombifolia*; Caesalpiniacaeae): small tree in the deciduous forests, often used as an avenue plant.
84. *Cassia kleinii* (Caesalpiniacaeae): small shrub in the deciduous forests.
85. *Cassia obtusifolia* (=*Caesalpinia obtusifolia*; Caesalpiniacaeae): shrub, cultivated as an ornamental plant.
86. *Cassia occidentalis* (Caesalpiniacaeae): shrub in disturbed areas in dry habitats and habitations.
87. *Cassia siamea* (=*Cassia florida, Senna siamea*; Caesalpiniacaeae): large tree,
88. introduced from SE Asia as an avenue plant in human habitations.
89. *Cassia tora* (Caesalpiniacaeae): herb in disturbed areas in dry habitats and human habitations.
90. *Ceiba pentandra* (=*Bombax pentandrum, Eriodendron anfractuosum, Eriodendron pentandrum, Eylon pentandrum*; Bombacaceae): large tree, introduced from tropical America and naturalised in peninsular India.
91. *Celtis tetrandra* (=*Celtis serotina*; Ulmacaeae): small tree in the semi-evergreen forest.
92. *Ceropegia bulbosa* (Asclepiadaceae): twining herb in open, disturbed places.
93. *Ceropegia intermedia* (Asclepiadaceae): slender twiner in openings in the semi-evergreen forest.
94. *Chionanthus mala-elengi* (=*Chionanthus malabaricus, Forsythia mala-elengi, Linociera malabarica*; Oleaceae): small tree in the semi-evergreen forest, often along banks of streams and rivers.
95. *Chloroxylon swietenia* (=*Swietenia chloroxylon*; Rutaceae): small tree in the dry deciduous forests and scrub in hilly country.
96. *Chromolaena odorata* (=*Eupatorium odoratum*; Asteraceae): small gregarious weedy shrub in openings in moist deciduous, semi-evergreen and evergreen forests. **A.**

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- *Cinchona*: see *Hedyotis orixense*.

97. *Cinnamomum camphora* (=*Camphora officianalis*(=*officinarum*), *Cinnamomum officinalis, Laurus camphora*; Lauraceae): the Camphor Tree: small evergreen tree, cultivated.
98. *Cinnamomum macrocarpum* (= *Cinnamomum zeylanicum*; Lauraceae): small tree in the evergreen forest, and often cultivated.
99. *Cinnamomum malabatrum* (= '*malabathrum*', *Cinnamomum iners, Laurus malabatrum*; Lauraceae): small tree in the evergreen forests, especially at low elevation, and along paths and openings.
    - *Cinnamomum officinalis*: see *Cinnamomum camphora.*
    - *Cinnamomum zeylanicum*: see *Cinnamomum macrocarpum.*
100. *Cipadessa* (Meliaceae): shrubs in deciduous and semi-evergreen forests. **A.**
101. *Citrus aurantifolia* (=*Citrus lima, Citrus limetta, Limonia aurantifolia*; Rutaceae): the Lime: small tree extensively cultivated in home gardens.
    - *Citrus decumana*: see *Citrus grandis.*
102. *Citrus grandis* (=*Citrus aurantium* var. *grandis, Citrus decumana, Citrus maxima*; Rutaceae): the Pumelo: small tree cultivated in home gardens.
103. *Citrus limon* (=*Citrus medica* var. *limon*; Rutaceae): the Lemon: shrub, extensively cultivated.
104. *Citrus medica* (Rutaceae): shrub, extensively cultivated.
105. *Citrus sinensis* (=*Citrus aurantium* var. *sinensis*; Rutaceae): the Orange: small tree extensively cultivated for the fruits.
106. *Clausena heptaphylla* (=*Amyris heptaphylla*; Rutaceae): large shrub in the evergreen forests, usually at lower elevation and along paths and small openings.
107. *Cleome viscosa* (Capparaceae): tall annual herb in the deciduous forests and along roadsides and waste places around human habitations; up to 1,000 m.
108. *Clerodendrum indicum* (=*Clerodendron siphonanthus, Siphonanthus indica*; Verbenaceae): shrub in the plains along riverbanks in disturbed places.
109. *Clerodendrum paniculatum* (Verbenaceae): an ornamental shrub, also as an escape in regions of heavy rainfall in the Western Ghats. **A.**
110. *Clerodendrum serratum* (Verbenaceae): shrub in deciduous forests. **A.**
111. *Cocos nucifera* (Arecaceae): the coconut tree: large tree, cultivated for the fruits.
112. *Combretum albidum* (=*Combretum ovalifolium*; Combretaceae): large climbing shrub in the deciduous forests.
    - *Combretum extensum*: see *Combretum latifolium.*
113. *Combretum latifolium* (=*Combretum extensum*; Combretaceae): large climbing shrub in deciduous forests, especially along water courses.
    - *Combretum ovalifolium*: see *Combretum albidum.*
114. *Corchorus capsularis* (genus synonym: *Antichorus*; Tiliaceae): large herb, mostly cultivated.
115. *Cosmos sulphureus* (Asteraceae): a tall ornamental herb, native of tropical Americas, sometimes found as an escape in scrub and deciduous forests. **A.**
116. *Costus speciosus* (=*Banksia speciosa*; Zingiberaceae): tall herb in the deciduous semievergreen and evergreen forests, especially in openings and along roadsides.
117. *Crateva adansonii* (=*Capparis magna, Crateva nurvala, Crateva odora, Crateva religiosa, Crateva roxburghii*; Capparaceae): small tree in scrublands, dry deciduous forest and also cultivated; sea level to 750 m.
118. *Crepis* (Asteraceae): small herbs in grassy areas. **A.**
119. *Crossandra* (Acanthaceae): ornamental plants as well as escapes in deciduous, semi-evergreen and evergreen forests. **A.**
120. *Cryptolepis buchananii* (=*Nerium reticulatum*; Asclepiadaceae): climber in

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the deciduous forests, scrublands and habitations.

121. *Cryptolepis elegans* (Asclepiadaceae): climber in the dry deciduous forests and scrublands.
122. Cucurbits (Cucurbitaceae): climbers or creepers.
123. *Curcuma aromatica* (Zingiberaceae): tall herb in the moist, shady places in the semi-evergreen forest.
124. *Curcuma decipiens* (Zingiberaceae): herb in moist, shady places in the deciduous forests.
125. *Cycas revoluta* (Cycadaceae): the Sago Palm: small tree introduced in the country, widely cultivated as a garden plant.
    - *Cylista scariosa*: see *Paracalyx scariosa*.
126. *Cyrtococcum* (Poaceae): herbaceous grasses in the deciduous, and occasionally evergreen, forests.
127. *Daedalacanthus purpurascens* (Acanthaceae): small shrub in the moist deciduous and semi-evergreen forests.
    - *Daedalacanthus roseus*: see *Eranthemum roseum*.
128. *Dalbergia lanceolaria* (=*Dalbergia frondosa*; Fabaceae): large tree in the deciduous forests, also cultivated.
129. *Dalbergia latifolia* (Fabaceae): large tree in the deciduous forests, also cultivated.
130. *Delonix regia* (=*Poinciana regia*; Caesalpiniaceae): small tree, native of Madagascar, extensively planted in human habitations.
131. *Dendrophthoe falcata* (=*Loranthus falcatus*, *Loranthus longiflorus* var. *falcatus*, *Loranthus longiflorus* var. *amplexifolia*; Loranthaceae): hanging parasitic shrub on trees in the deciduous forests and habitations.
    - *Derris indica*: see *Pongamia pinnata*.
    - *Derris scandens*: see *Brachypterum scandens*.
132. *Derris uliginosa* (Fabaceae): liana found along the sea-coast and on the edge of muddy saltwater creeks; also disturbed forests.
133. *Desmodium* (Fabaceae): usually shrubs in deciduous and degraded evergreen forests.
134. *Dicliptera* (Acanthaceae): small herbs along roadsides, at the edges of thickets and forests. **A.**
135. *Dioscorea oppositifolia* (Dioscoraceae): climber in the moist deciduous and secondary evergreen forests.
136. *Dioscorea pentaphylla* (Dioscoraceae): climber in the moist deciduous and secondary evergreen forests.
137. *Diospyros candolleana* (=*Diospyros canarica*; Ebenaceae): small tree in the moist deciduous, semi-evergreen and evergreen forests.
138. *Diospyros melanoxylon* (=*Diospyros dubia*, *Diospyros tupru*; Ebenaceae): large tree in the deciduous forests, noticeably more common in fire-afflicted areas.
    - *Dolichos catjang*: see *Vigna cylindrica*.
    - *Dregea volubilis*: see *Wattakaka volubilis*.
139. *Drypetes oblongifolia* (=*Cyclostemon macrophyllus*, *Cyclostemon macrophyllus* var. *peninsularis*, *Cyclostemon macrophyllus* var. *sessiliflora*, *Laneasagum oblongifolium*; Euphorbiaceae): small tree in the evergreen forest, at lower elevation.
140. *Drypetes roxburghii* (=*Putranjiva roxburghii*; Euphorbiaceae): small tree in the evergreen forest, also extensively cultivated as an avenue plant.
141. *Drypetes venusta* (=*Hemicyclia venusta*; Euphorbiaceae): small tree in the evergreen forest.
142. *Dyerophytum indicum* (Plumbaginaceae): trailing herb in rocky, dry areas; found in northern India.
143. *Ecbolium ligustrinum* (=*Ecbolium linneanum*, *Ecbolium viride*, *Justicia laetevirens*, *Justicia ligusrina*; Acanthaceae): small shrub along paths and openings in the evergreen and semi-

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evergreen forests. Also in the deciduous forests and neglected places in the plains.

144. *Elaeocarpus* (Elaeocarpaceae): small to large trees in mostly evergreen but also semievergreen forests.
145. *Elephantopus scaber* (Asteraceae): small herb in deciduous forests, small openings and shady paths in semi-evergreen and evergreen forests. **A.**
146. *Elettaria cardamomum* (=*Alpinia cardamomum, Amomum cardamomum*; Zingiberaceae): the cardamon: herb, cultivated for cardamom.
147. *Eleusine* (Poaceae): herbaceous grass on hill slopes and grasslands.
148. *Eranthemum roseum* (=*Daedalacanthus roseus, Justicia rosea*; Acanthaceae): herb found as an undergrowth in the deciduous forests.
    - *Eriodendron*: see *Ceiba pentandra*.
149. *Erioglossum* (Sapindaceae): a tree from NE India, planted in some parts of Mumbai; mentioned in Cooke (1958).
150. *Evodia roxburghiana* (Rutaceae): small tree in the evergreen forest. This species could be traced only in Cooke (1958).
151. *Ficus benghalensis* (Moraceae): The Banyan tree: large tree mostly in and around human habitations and dry forests.
    - *Ficus glomerata*: see *Ficus racemosa*.
152. *Ficus hispida* (=*Ficus oppositifolia, Ficus daemona*; Moraceae): large shrub or small tree, mainly close to water, in a variety of moist habitats.
    - *Ficus indica* (Moraceae): This species could be traced only in Cooke (1958), who mentions it as a synonym of *Ficus benghalensis*.
153. *Ficus racemosa* (=*Ficus glomerata*; Moraceae): large tree near water sources, and in human habitations.
154. *Ficus religiosa* (Moraceae): The Peepal tree: large tree mostly in and around habitations and dry forests.
155. *Flacourtia montana* (Flacourtiaceae): small tree in the moist deciduous, semievegreen and evergreen forests, up to 1000 m.
156. *Flacourtia indica* (=*Flacourtia ramontchii, Flacourtia sepiaria, Gmelina indica*; Flacourtiaceae): small tree in the dry deciduous forests, scrublands, up to 1200m.
157. *Flemingia* (Fabaceae): shrubs in mostly deciduous and disturbed forests.
    - *Fleurya interrupta*: see *Laportea interrupta*.
158. *Garcinia xanthochymus* (=*Garcinia tinctoria, Garcinia malabarica, Garcinia pictorius, Xanthochymus pictorius, Xanthochymus tinctorius*; Clusiaceae): small tree in the evergreen, semi-evergreen and moist deciduous forests, up to 1400 m.
159. *Girardinia diversifolia* (=*Girardinia heterophylla* var. *palmata, Girardinia leschenaultiana, Girardinia zeylanica, Urtica diversifolia, Urtica heterophylla*; Urticaceae): herb in disturbed places in deciduous and semievergreen forests.
160. *Gliricidia* (Fabaceae): small exotic tree, planted on degraded hillsides and other open areas. **A.**
161. *Glochidion lanceolarium* (Euphorbiaceae): small tree in the evergreen forest.
162. *Glochidion velutinum* (Euphorbiaceae): small tree in the evergreen forest. This species could be traced only in Cooke (1958).
163. *Gloxinia* (Gesneriaceae): herbs cultivated in the gardens.
164. *Glycosmis arborea* (=*Glycosmis pentaphylla, Limonia arborea, Limonia pentaphylla*; Rutaceae): shrub at the edges of evergreen forest, and in the semi-evergreen forest. **LA.**
165. *Gmelina arborea* (Verbenaceae): small tree in deciduous forests. **A.**
166. *Gnaphalium* (Asteraceae): herbs or small shrubs on rocky soils.
167. *Gnidia glauca* (=*Gnidia sisparensis, Lasiosiphon eriocephalus, Lasiosiphon glaucus*; Thymelaeaceae): shrub in savannahs, scrublands and clearings in all forest types. **LA.**
168. *Goniogyna hirta* (=*Hallia hirta, Heylandia latebrosa*; Fabaceae): herb in the deciduous forests.

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169. Gram (Fabaceae): herbs mostly in grass/ herb-dominated vegetation types, some species cultivated.
170. Grasses (Poaceae): mostly herbs, occasionally shrubs, in all vegetation types, but most of the species most common in open habiatas.
171. *Gymnosporia* (Celastraceae): shrubs and small trees in the scrublands, deciduous forests, and secondary evergreen forests. **LA.**
    - *Gymnosporia montana*: see *Maytenus emarginata*.
172. *Hedychium* (Zingiberaceae): herbs in evergreen and semi-evergreen forests, common along waterside.
173. *Hedyotis orixense* (=*Cinchona excelsa, Cinchona orixensis, Hymenodictyon excelsum*; Rubiaceae): large tree in the deciduous forests and teak plantations.
174. *Helicanthes elastica* (=*Loranthus elasticus, Loranthus euphorbiae*; Loranthaceae): shrubby hanging parasite on large trees in the semi-evergreen forest.
175. *Helicteres isora* (Sterculiaceae): shrub in the deciduous forests, especially in dry; up to 1500 m.
176. *Helixanthera wallichiana* (=*Loranthus wallichianus*; Loranthaceae): shrubby hanging parasite on trees in evergreen forests.
    - *Hemicyclia venusta*: see *Drypetes venusta*.
177. *Hemidesmus indicus* (=*Periploca indica*; Asclepiadaceae): trailer or slender climber in the deciduous forests, scrublands and habitations.
178. *Hemigyrosa* (Sapindaceae): small trees in the deciduous forests.
179. *Hibiscus cannabinus* (Malvaceae): tall herb in open forests, habitations.
180. *Hibiscus tiliaceus* (Malvaceae): small tree in coastal areas, sometimes planted in interior areas.
181. *Holarrhena pubescens* (=*Chonemorpha antidysenterica, Echites antidysentrica, Echites pubescens, Holarrhena antidysenterica, Holarrhena codaga, Holarrhena malaccensis, Nerium antidysentricum*; Apocynaceae): small tree in the deciduous forests.
182. *Hoya* (Asclepiadaceae): epiphytic pendulous shrub in evergreen forest.
183. *Hydnocarpus pentandra* (=*Chilmoria pentandra, Hydnocarpus laurifolia, Hydnocarpus wightiana, Munnicksia laurifolia*; Flacourtiaceae): small tree in moist deciduous, semi-evergreen and evergreen forests, especially along water courses; up to 850 m.
184. *Hygrophila auriculata* (=*Asteracantha longifolia, Barleria auriculata, Barleria longifolia*; Acanthaceae): herb in marshy places in all habitats.
185. *Ichnocarpus frutescens* (=*Apocynum frutescens*; Apocynaceae): twiner in the deciduous forests, scrublands and habitations.
186. *Impatiens* (Balsaminaceae): herbs in moist areas, especially along streamside in grasslands, scrub, deciduous and semi-evergreen forests. **A.**
187. *Imperata cylindrica* (=*Imperata arundinacea, Lagurus cylindricus*; Poaceae): herbaceous grass in open, disturbed places, secondary grasslands.
188. *Indigofera* (Fabaceae): herbs or small shrubs mostly in deciduous forests and clearings.
189. *Ipomoea carnea* (=*Batatus crassicaulis, Ipomoea crassicaulis, Ipomoea fistulosa*; Convolvulaceae): shrub, native of America, now cultivated throughout the world, and found as an escape and weed in shallow waters.
190. *Ixora* (Rubiaceae): small and large shrubs in rocky areas and other open patches in deciduous, semi-evergreen and evergreen forests. **A.**
191. *Jasminum* (Oleaceae): climbers or climbing shrubs in scrub, deciduous, semi-evergreen and evergreen forests. **A.**
192. *Jatropha* (Euphorbiaceae): small and large shrubs, native as well as exotic and ornamental. **A.**

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- *Justicia micrantha*: see *Justicia neesii*.

193. *Justicia neesii* (=*Justicia micrantha, Rostellularia crinita*; Acanthaceae): herb in openings in the mid-elevation evergreen forest.
194. *Justicia procumbens* (=*Rostellaria procumbens*; Acanthaceae): shrub in deciduous forests and neglected places in human habitation.
195. *Kaempferia rotunda* (Zingiberaceae): herb, cultivated as an ornamental plant.
196. *Kalanchoe laciniata* (=*Cotyledon laciniata*; Crassulaceae): large, succulent herb on dry, rocky slopes.
197. *Kalanchoe pinnata* (=*Bryophyllum pinnatum, Bryophyllum calycinum, Cotyledon pinnata*; Crassulaceae): large, succulent herb in rocky areas mainly in dry habitats, and extensively planted in gardens.
198. *Lagascea mollis* (Asteraceae): herb around human habitations; originally from Central America. **A.**
    - *Lagerstroemia flos-reginae*: see *Lagerstroemia reginae*.
    - *Lagerstroemia lanceolata*: see *Lagerstroemia microcarpa*.
199. *Lagerstroemia microcarpa* (= *Lagerstroemia lanceolata, Lagerstroemia thomsonii*; Lythraceae): large tree in the moist deciduous forest.
200. *Lagerstroemia reginae* (=*Lagerstroemia flos-reginae*; Lythraceae): small tree in the moist deciduous forest.
201. *Lantana camara* (Verbenaceae): an exotic, large shrub in disturbed scrub, deciduous and semi-evergreen forests. Also used as a hedge plant. **A.**
202. *Laportae interrupta* (=*Fleurya interrupta, Urtica interrupta*; Urticaceae): herb in wet shady places in the deciduous forests.
203. *Lathyrus* (Fabaceae): twining herbs cultivated in the garden.
204. *Leea* (Leeaceae): very large shrubs in moist deciduous, semi-evergreen and evergreen forests, especially along stream-sides. **A.**
205. *Lepidagathis prostrata* (Acanthaceae): small shrub on rocky soils, primary and secondary grasslands. Could be traced only in Cooke (1958).
206. *Leucas* (Lamiaceae): herbs on dry soil or rocky areas. **A.**
    - *Limonia acidissima*: see *Naringi crenulata*.
    - *Linociera malabarica*: see *Chionanthus mala-elengi*.
    - *Lippia nodiflora*: see *Phyla nodiflora*.
207. *Litchi* (=*Nephelium*; Sapindaceae): the Litchi: small trees, various species are widely cultivated for the fruits.
208. *Litsea chinensis* (=*Litsea sebifera*; Lauraceae): small tree in the moist deciduous forest.
209. *Litsea deccanensis* (=*Litsea tomentosa*; Lauraceae): small tree in the semi-evergreen forest.
    - *Litsea sebifera*: see *Litsea chinensis*.
    - *Litsea tomentosa*: see *Litsea deccanensis*.
    - *Loranthus elasticus*: see *Helicanthes elastica*.
    - *Loranthus longiflorus*: see *Dendrophthoe falcata*.
    - *Loranthus scurrula*: see *Scurrula parasitica*.
    - *Loranthus tomentosa*: see *Taxillus tomentosus*.
    - *Loranthus wallichianus*: see *Helixanthera wallichiana*.
210. *Lotus corniculatus* (Fabaceae): herb in sandy places.
    - *Machilus macrantha*: see *Persea macrantha*.
211. *Maerua oblongifolia* (=*Capparis oblongifolia, Maerua arenaria, Niebuhria arenaria*; Capparaceae): climbing shrub in scrublands.
212. *Magnolia grandiflora* (Magnoliaceae): shrub, cultivated particularly in gardens of hill stations.
213. *Mangifera indica* (Anacardiaceae): large tree in the evergreen forest, stream-sides

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in semi-evergreen and moist deciduous forests; also cultivated.

214. *Maytenus emarginata* (=*Celastrus emarginatus, Celastrus montanus, Gymnosporia emarginata, Gymnosporia montana*; Celastraceae): large shrub in disturbed deciduous forests. **A.**
215. *Medicago sativa* (Fabaceae): herb, widely cultivated. **A.**
216. *Melastoma malabathricum* (Melastomaceae): shrub in the deciduous forests along sreams and wet places.
217. *Meyenia laxiflora* (Rubiaceae): small tree in deciduous and disturbed evergreen forests. **A.**
218. *Michelia champaca* (=*Michelia rheedii*; Magnoliaceae): large tree in tropical and subtropical evergreen forests, up to 600 m., also extensively cultivated.
    - *Micranthus oppositifolius*: see *Phaulopsis dorsiflora.*
219. *Mikania scandens* (Asteraceae): exotic straggling shrub in moist areas. **A.**
220. *Miliusa tomentosum* (=*Saccopetalum tomentosum, Uvaria tomentosa*; Annonaceae): large tree in the moist deciduous and semi-evergreen forests.
221. *Miliusa velutina* (=*Uvaria velutina, Uvaria villosa*; Annonaceae): large tree in the moist deciduous and semi-evergreen forests.
222. *Millettia auriculata*: see *Millettia extensa.*
223. *Millettia extensa* (=*Millettia auriculata, Millettia macrophylla, Otosema extensa, Otosema macrophylla, Robinia macrophylla*; Fabaceae): extensive woody climber in the deciduous forests.
    - *Millettia ovalifolia*: see *Millettia peguensis.*
224. *Millettia pallida* (=*Millettia leiogyna, Millettia racemosa, Robinia racemosa, Wisteria pallida, Tephrosia racemosa, Wisteria racemosa*; Fabaceae): a large woody climber in the deciduous and semi-evergreen forests.
225. *Millettia peguensis* (=*Millettia ovalifolia*; Fabaceae): a small deciduous tree, planted in the gardens as an avenue tree. Not a native peninsular Indian tree.
    - *Millettia racemosa*: see *Millettia pallida.*
226. *Millettia racemosa* (=*Tephrosia racemosa*; Fabaceae): extensive climber in the deciduous forests.
227. *Mimosa pudica* (Mimosaceae): herb in disturbed, moist localities in all forests.
228. *Mitragyna parvifolia* (=*Nauclea parvifolia, Stephegyne parvifolia*; Rubiaceae): large tree in the deciduous forests.
    - *Modecca palmata*: see *Adenia hondala.*
229. *Momordica charantia* (Cucurbitaceae): climber, cultivated as well as wild in waste places. **A.**
230. *Morus* (Moraceae): small trees. *Morus alba* and *Morus indica* are "mulberry" plants.
231. *Moulluva spicata* (=*Almeloveenia spinosa, Caesalpinia spicata, Wagatea spicata*; Caesalpiniaceae): straggling shrub in the mid-elevation secondary evergreen forests.
232. *Murraya koenigii* (Rutaceae): small tree in the deciduous forests, and is extensively cultivated.
233. *Murraya paniculata* (=*Chalcas paniculata, Murraya exotica*; Rutaceae): small tree, close to water in deciduous forests.
234. *Musa sapientium* (Musaceae): the Banana: large shrub or small tree, extensively cultivated.
235. *Mussaenda frondosa* (Rubiaceae): climbing shrub in the moist deciduous, semi-evergreen and edges of evergreen forests. **LA.**
236. *Naringi crenulata* (=*Feronia limonia, Hesperethusa crenulata, Limonia acidissima, Limonia crenulata*; Rutaceae): small tree in the deciduous forest and the teak plantation.
    - *Nauclea cadamba*: see *Neolamarckia cadamba.*
237. *Nelsonia canescens* (=*Justicia canescens, Nelsonia campestris*; Acanthaceae): herb on marshy river banks.
238. *Neolamarckia cadamba* (=*Anthocephalus cadamba, Anthocephalus chinensis,*

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Anthocephalus indicus, Cephalanthus chinensis, Nauclea cadamba; Rubiaceae): large tree in the deciduous forests, especially along river banks, and occasionally cultivated.

239. *Nerium odorum* (Apocynaceae): small tree planted in the gardens.
240. *Nerium oleander* (Apocynaceae): small tree planted in the gardens.
241. *Nothapodytes nimmoniana* (=*Mappia foetida, Mappia oblonga, Mappia ovata, Mappia tomentosa, Mappia wightiana, Nothapodytes foetida, Premna nimmoniana, Stemonurus foetidus*; Icacinaceae): small tree in the evergreen forest.
242. *Ochreinauclea missionis* (=*Nauclea missionis, Sarcocephalus missionis*; Rubiaceae): tree along the banks of streams and rivers in semievergreen forest.
243. *Olax imbricata* (=*Olax wightiana*; Olacaceae): liana in the semi-evergreen forest.
244. *Olax scandens* (Olacaceae): climbing shrub in the deciduous forests.
    - *Olax wightiana*: see *Olax imbricata*.
245. *Olea dioica* (Oleaceae): small tree at the edges of evergreen and in semi-evergreen forests.
246. *Oplismenus compositus* (=*Panicum compositum*; Poaceae): herbaceous grass in the evergreen, semi-evergreen and shady places in moist deciduous forests.
247. *Oryza sativa* (Poaceae): tall herbaceous grass in heavy rainfall areas, introduced in the country and a major field crop now; also found as an escape.
248. *Osbeckia* (Melastomaceae): shrubs on grassy hills at medium and high altitudes.
249. *Ougeinia oojeinensis* (=*Dalbergia oojeinensis, Ougeinia dalbergioides*; Fabaceae): large tree in the deciduous forests.
250. *Oxalis corniculata* (Oxalidaceae): herb in large openings in all forests; also scrublands, roadsides and neglected places in human habitations; in damp places.
251. Palms (Arecaceae): mostly medium to large trees, found in evergreen and semi-evergreen forests. Many species are extensively cultivated.
252. *Panicum* (Poaceae): herbaceous and small shrub-like grasses in all the habitats.
253. *Paracalyx scariosa* (=*Cylista scariosa*; Fabaceae): climbing shrub in the hills and the plains.
254. *Paramigyna monophylla* (Rutaceae): climber in the evergreen forest.
255. *Parochetus communis* (Fabaceae): herb in the grassy meadows at high altitudes.
256. *Paspalum conjugatum* (Poaceae): herbaceous grass in moist localities in all habitats.
257. *Passiflora edulis* (Passifloraceae): climber, an American species widely cultivated in home gardens.
258. *Passiflora foetida* (Passifloraceae): climber, a tropical American species running wild in the deciduous forests and savannahs.
259. *Passiflora subpeltata* (Passifloraceae): climber cultivated in human habitations, a native of Madagascar.
260. *Peristrophe* (Acanthaceae): herbs in open places in various vegetation types. **A.**
261. *Persea macrantha* (=*Machilus macrantha, Machilus glaucescens*; Lauraceae): small tree in the evergreen and semi-evergreen forests.
    - *Phaseolus trilobus*: see *Vigna trilobata*.
262. *Phaulopsis dorsiflora* (=*Micranthus oppositifolius, Ruellia dorsiflora*; Acanthaceae): herb in the deciduous forests and large openings in evergreen forests. **LA.**
263. *Phellodendron* (Rutaceae): mostly small trees in the deciduous forests, from E. Asia; cultivated as ornamental plants.
264. *Phoenix acaulis* (Arecaceae): shrubby palm. This species could be traced only in Cooke (1958).
265. *Phoenix lourierii* (=*Phoenix humilis* var. *loureiri, Phoenix roebelenii*; Arecaceae): shrubby palm in open mid-elevation grassland-savannah.

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290. *Sesbania bispinosa* (=*Aeschynomene bispinosa, Coronilla aculeata, Sesbania aculeata*; Fabaceae): shrub in marshy places in the deciduous forests at low elevation and in the plains.
291. *Setaria pumila* (=*Panicum pallide-fuscum, Panicum pumilum, Setaria glauca, Setaria pallide-fusca*; Poaceae): herbaceous grass in deciduous forests and scrublands, especially where fire and grazing are insignificant. Also neglected places in human habitations.
292. *Shorea robusta* (Dipterocarpaceae): large tree in the deciduous and semi-evergreen forests, in eastern central and northern India.
293. *Sida rhombifolia* (*Sida rhomboidea*; Malvaceae): herb in open, slightly disturbed spaces in dry and moist deciduous forests, scrublands and human habitations. **LA**.
294. *Sisymbrium* (Brassicaceae): herb in open places, road-sides.
295. *Smilax* (Smilacaceae): climber in the moist deciduous and semi-evergreen forests.
296. *Sorbaria sorbifolia* (=*Schizonotus sorbifolia, Spiraea sorbifolia*; Rosaceae): shrub cultivated in the gardens.
297. *Sorghum* (Poaceae): bushy grasses along stream banks; some species are cultivated.
    - *Spiraea sorbifolia*: see *Sorbaria sorbifolia*.
298. *Stachyphrynium spicatum* (=*Phrynium spicatum*; Marantaceae): herb on sandy, moist soil in the moist deciduous forest.
299. *Stephanotis* (Asclepiadaceae): climbing shrubs native of Madagascar and Malaya, cultivated as garden plant.
    - *Stephegyne parvifolia*: see *Mitragyna parviflora*.
300. *Streblus asper* (=*Epicarpurus orientalis*; Moraceae): small tree along riverbanks in disturbed deciduous forests and scrublands.
301. *Strobilanthes* (Acanthaceae): much branched large herbs and shrubs in the deciduous, semi-evergreen and evergreen forests. **LA**.
    - *Strobilanthes callosus*: see *Carvia callosa*.
302. *Syzygium* (Myrtaceae): shrubs, small trees and large trees, usually in the semi-evergreen and evergreen forests. **A**.
303. *Tagetes erecta* (Asteraceae): ornamental herb in gardens. **A**.
304. *Tephrosia candida* (Fabaceae): shrub, a native of Himalayas, occasionally planted in gardens as an ornamental plant.
305. *Tephrosia pauciflora* (Fabaceae): herb in dry areas.
306. *Terminalia alata* (=*Pentaptera tomentosa, Terminalia tomentosa*; Combretaceae): large tree in the deciduous and semi-evergreen forests, especially in the moist places.
307. *Terminalia bellirica* (='*bellerica*', *Myrobalanus bellirica*; Combretaceae): large tree in the deciduous and semi-evergreen forests.
308. *Terminalia catappa* (Combretaceae): large tree in the semi-evergreen forests of the Andamans, now cultivated extensively on the mainland.
309. *Terminalia paniculata* (=*Pentaptera paniculata*; Combretaceae): large tree in the moist deciduous and semi-evergreen forests.
    - *Terminalia tomentosa*: see *Terminalic alata*.
    - *Thea chinensis*: see *Camelia sinensis*.
310. *Thelepaepale ixiocephala* (=*Strobilanthes ixiocephala*; Acanthaceae): shrub, sometimes straggling, at the edges and along paths in the semi-evergreen and evergreen forests; often gregarious forming large clumps.
311. *Thespesia populnea* (=*Hibiscus populneus, Thespesia macrophylla*; Malvaceae): small tree throughout in coastal regions; often cultivated in interior areas; common around human habitations.
312. *Thottea siliquosa* (=*Apama siliquosa, Bragantia wallichii*; Aristolochiaceae): climbing shrub near streams and wet places in evergreen and semi-evergreen forests.

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313. *Tinospora cordifolia* (=*Cocculus cordifolius, Menispermum cordifolium*; Menispermaceae): extensive climber, most common in deciduous and semi-evergreen forests; occasionally in evergreen forest, scrub and habitations.
314. *Toddalia asiatica* (=*Paullinia asiatica, Toddalia aculeata*; Rutaceae): climbing shrub in evergreen forest.
    - *Tragia cannabina*: see *Tragia plukentii*.
315. *Tragia involucrata* (Euphorbiaceae): twining herb in large openings and edges of evergreen and semi-evergreen forests, especially in degraded places.
316. *Tragia plukentii* (=*Tragia cannabina*, *Tragia involucrata* var. *cannabina*; Euphorbiaceae): climbing herb, sometimes gregarious, in savannahs and scrublands.
317. *Trewia nudiflora* (Euphorbiaceae): small tree along river and stream banks in deciduous and semi-evergreen forests.
318. *Trichilia connaroides* (=*Heynea affinis, Heynea trijuga, Zanthoxylum connaroides*; Meliaceae): small tree in the evergreen and semi-evergreen forests.
319. *Tricholepis* (=*Carduus*; Asteraceae): the Thistle: tall herb on rocky slopes in the hills.
320. *Tridax procumbens* (Asteraceae): small, originally South American herb, found in open, dry areas and around human habitations. **A.**
321. *Trifolium* (Fabaceae): herb in and around human habitations, grazing lands, etc., in the temperate zone.
322. *Triumfetta* (Tiliaceae): herbs in disturbed areas in deciduous forests, scrublands.
    - *Tylophora asthmatica*: see *Tylophora indica*.
    - *Tylophora carnosa*: see *Tylophora tenuis*.
323. *Tylophora indica* (=*Asclepias asthmatica, Cynanchum indicum, Tylophora asthmatica*; Asclepiadaceae): small twining herb at the edges of deciduous forests.
324. *Tylophora tenuis* (=*Asclepias tenuissima, Tylophora carnosa, Tylophora tenuissima*; Asclepiadaceae): small twining herb in evergreen forest.
325. *Urena lobata* (Malvaceae): herb in disturbed areas in the deciduous forests, scrublands; occasionally in evergreen forest.
326. *Urtica* (Urticaceae): stinging tall herbs and shrubs in disturbed areas in moist deciduous, semi-evergreen and evergreen foreststs.
327. *Uvaria* (Annonaceae): straggling climbers in the evergreen forest.
    - *Vallaris dichotoma*: see *Vallaris heynei*.
328. *Vallaris heynei* (=*Vallaris dichotoma*; Apocynaceae): 'arge climbing shrub. Occurs as a wild plant, but often cultivated in gardens.
329. *Vicia* (Fabaceae): the Vetch: herbs in and around human habitations, grazing lands, etc., in the temperate region.
330. *Vicoa* (Asteraceae): small herbs in grassy and herb-dominated places. **A.**
    - *Vigna catjang*: see *Vigna cylindrica*.
331. *Vigna cylindrica* (=*Dolichos catjang, Phaseolus cylindricus, Vigna catjang*; Fabaceae): herb cultivated in the fields.
332. *Vigna trilobata* (=*Dolichos trilobus, Phaseolus trilobus*; Fabaceae): herb in dry deciduous forest, scrublands and savannah.
333. *Vigna unguiculata* (=*Dolichos biflorus, Dolichos unguiculata*; Fabaceae): slender climber; cultivated in the fields, occasionally found as an escape.
334. *Viola* (Violaceae): herbs in the herb/grass-dominated communities at mostly higher altitudes.
    - *Wagatea spicata*: see *Moulluva spicata*.
335. *Waltheria indica* (=*Waltheria americana*; Sterculiaceae): herb in waste places and roadsides in human habitations.
336. *Wattakaka volubilis* (=*Asclepias volubilis, Dregea volubilis, Hoya viridiflora, Marsdenia volubilis*; Asclepiadaceae): climbing shrub in the dry deciduous forest, scrublands and habitations.
337. *Wendlandia exserta* (Rubiaceae): small tree on rocky soil in regions of heavy rainfall.

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338. *Wendlandia thyrsoidea* (=*Canthium thyrsoideum, Wendlandia notoniana*; Rubiaceae): shrub or small tree on rocky soil in regions of heavy rainfall.
339. *Xanthophyllum flavescens* (Polygalaceae): small tree in the evergreen forests. **A.**
340. *Xylia xylocarpa* (=*Mimosa xylocarpa, Xylia dolabriformis*; Mimosaceae): large tree in the moist deciduous and semi-evergreen forests.
341. *Xylosma longifolium* (Flacourtiaceae): small tree in the moist ravines in sub-Himalayan zone and the Eastern Ghats; extends to the Nilgiris.
342. *Zanthoxylum ovalifolium* (Rutaceae): small tree in the secondary moist deciduous and semi-evergreen forests.
343. *Zanthoxylum rhetsa* (=*Fagara rhetsa, Fagara budrunga, Zanthoxylum budrunga, Zanthoxylum limonella*; Rutaceae): large tree in the moist deciduous forest and near ochards of southwestern coastal India, in high rainfall area and lateritic soils.
344. *Zea* (Poaceae): the Maize: tall herbaceous grasses, extensively cultivated.
345. *Zingiber montanum* (=*Amomum montanum, Zingiber cassumunar*; Zingiberaceae): tall herb along stram and river banks in the evergreen and semi-evergreen forests.
346. *Zinnia* (Asteraceae): small exotic, ornamental herbs. **A.**
    - *Ziziphus jujuba*: see *Ziziphus mauritiana.*
347. *Ziziphus mauritiana* (=*Ziziphus jujuba*; Rhamnaceae): small tree in the scrublands and dry deciduous forest.
348. *Ziziphus oenoplia* (=*Rhamnus oenoplia*; Rhamnaceae): straggling climbing shrub in the deciduous forests and scrublands.
349. *Ziziphus rugosa* (Rhamnaceae): straggling climbing shrub in the deciduous forests.
350. *Ziziphus xylopyrus* (=*Rhamnus xylopyrus*; Rhamnaceae): small tree in the deciduous forests.
351. *Zornia gibbosa* (=*Zornia diphylla*; Fabaceae): herb in the open, short-grass/ herb-dominated plateaux, hill slopes and undulating land.

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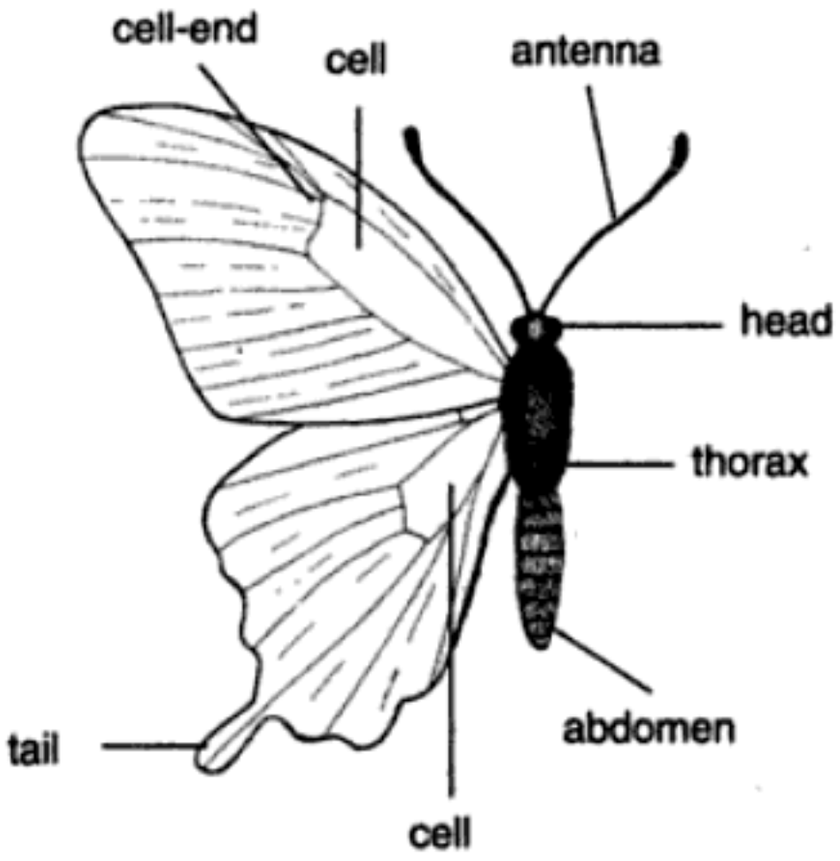
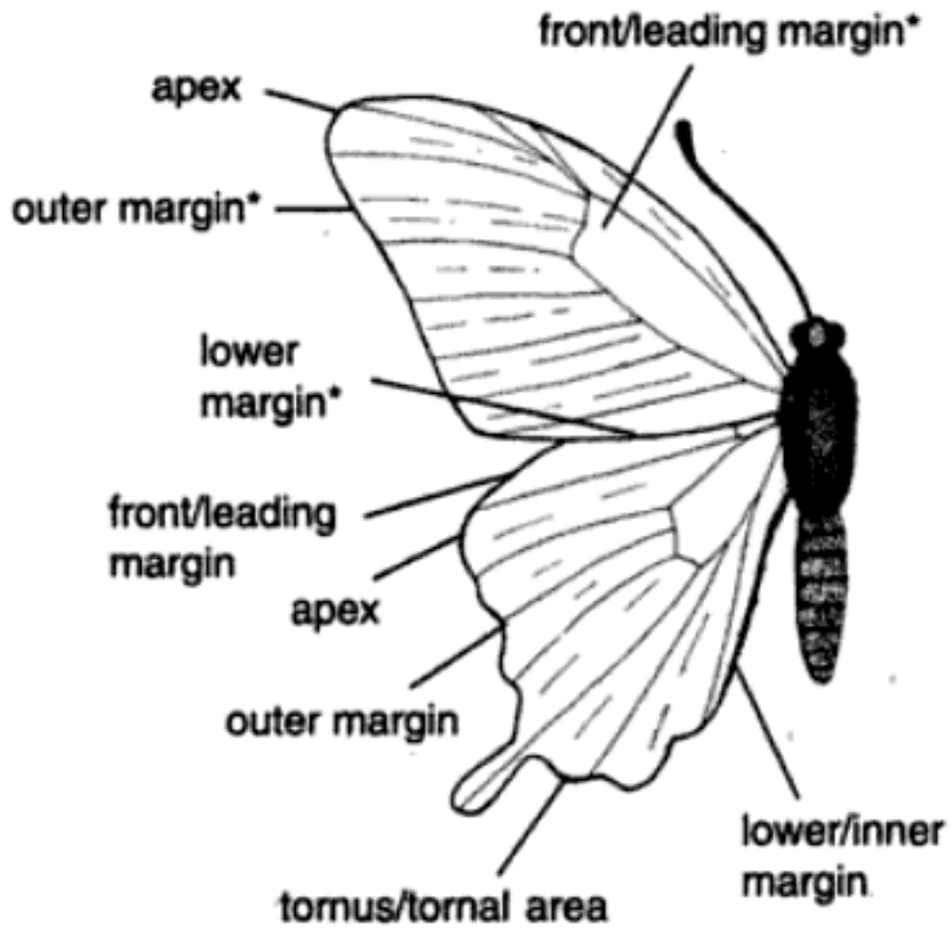
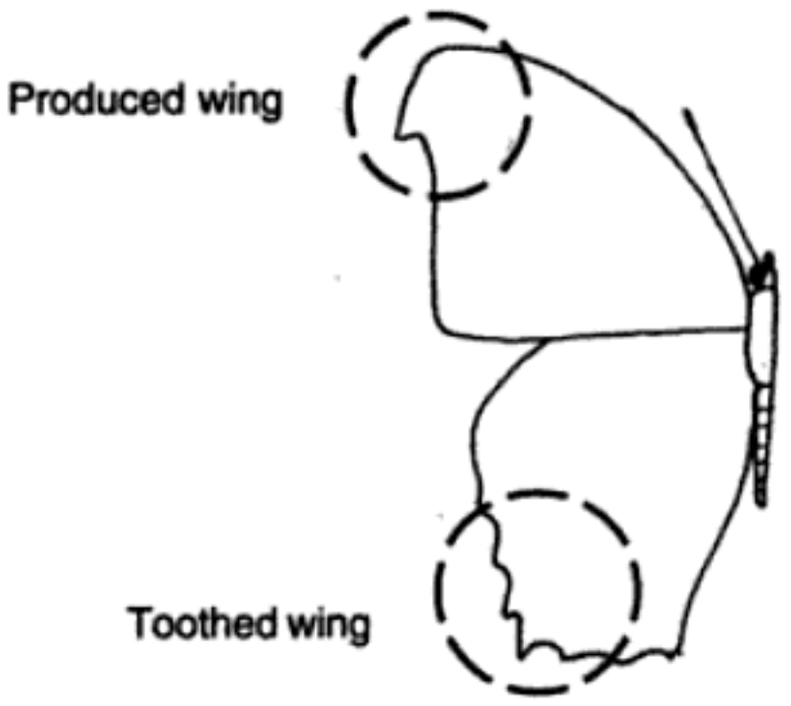
Glossary

1. **Abdomen** The last section of the butterfly's body, which bears spiracles.
2. **Alkaloid** A nitrogenous organic compound, produced especially by flowering plants; many alkaloids, for example, nicotine, caffeine and morphine, cause pronounced physiological activity in animals.
3. **Antenna** (plural 'antennae') The long, clubbed feelers situated close to the eyes of the adult butterflies.
4. **Apex** (apical) Tip of the wing, which may be rounded, pointed or produced.
5. **Base** (of the wing) The part of the wing close to the body.
6. **Body-band** (refer to the illustration on p. 59) A supporting strand of silk woven by a caterpillar around itself before pupation.
7. **Brand** see Sexual brand.
8. **Caterpillar** (also the 'larva') The growing stage in a butterfly's life, which feeds usually on green tissues of the plant, is occasionally carnivorous.
9. **Cell** (of a wing) An area enclosed by veins. In many insects, eg., the dragonflies and flies, the wings have many cells. In Lepidopterans, however, each wing has a single cell starting from its base. The arrangement of veins around the cell is of crucial importance in the identification of difficult groups of butterflies, e.g., Bushbrowns and Skippers.
10. **Cell-end** The end of the cell at a cross-vein. Identification of some species of butterflies, e.g., the Grass Yellows, is based on markings in the cell and at the cell-end.
11. **Costa** The upper or front margin of the wing.
12. **Cremaster** (refer to the illustration on p. 9) This is an anal attachment of the pupa, usually curved or hooked, which fixes it to the substratum. The pupae of Brush-footed Butterflies and some Blues are attached to the silken bed on the substratum only by the cremaster. In all other butterflies the pupa is also supported by a body-band.





**Identification guides to butterflies refer to front/leading margin of a wing of a butterfly as 'costa', outer margin as 'termen', and lower/inner margin as 'dorsum'.*



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13. **Chrysalis** see Pupa.

14. **Dimorphism** Pertaining to a species with two distinct and discontinuous morphological types. Most of the Blues and the mimetic butterfly species, e.g., the Danaid Eggfly and the Common Wanderer, are sexually dimorphic.

15. **Disc** (discal area; of the wings) The central area on a wing of a butterfly, between the base and the margin.

16. **Dorsal surface** (of a wing) The upper surface of the wings of a butterfly.

17. **Dorsum** The lower or hind (of the fore wings) or inner (of the hind wings) margin of the wings of a butterfly.

18. **Dry season form** A form of a species produced in the cool and dry season of the year. The wings of a butterfly in the dry season form are usually paler, mostly unmarked, and larger. Compare with the Wet season form.

19. **Dusting** The scattered scales, usually of a contrasting colour to the background, present on the wings of butterflies. These are very prominent in the Swallowtails and certain Whites and Yellows, e.g., the Peacocks and the Plain Puffin.

20. **Eye-spot** The eye-like spots on the wings of butterflies; e.g., in the Rings.

21. **Genitalia** (refer to the illustrations on p. 10) The external reproductive organs of animals. Genitalia are very important in distinguishing between species in certain groups of butterflies, e.g., the Pierrots, Swifts and Lineblues.

22. **Hair pencils** A brush-like, protrusible organ present in some male butterflies, e.g., the Crows.

23. **Instar** A stage between two moults during development of an arthropod.

24. **Labial palpi** (or Palpi) (refer to the illustrations on p. 9) Hairy processes at the base of the head in adult butterflies; a sense organ that also protects the proboscis. These curve up and usually protrude out in between the eyes, and are prominent in the Blues and the Brush-footed Butterflies.

25. **Larva** See Caterpillar.

26. **Lepidoptera** This is an order of Class Insecta (the Insects) to which the butterflies and the moths belong. It is characterized by the presence of scales that cover the wings and body.

27. **Micropyle** (refer to the illustration on p. 9) A microscopic pore on top of the egg, through which the sperm enters.

28. **Osmeterium** (refer to the illustration on p. 56) A bifid protrusible gland in the Swallowtail caterpillars, which gives out a strong aromatic odour.

29. **Palpi** see 'labial palpi'.

30. **Phenophase** That externally observable phase of the life cycle of a plant.

31. **Pheromone** (also see Sex-pheromone) A chemical messenger secreted by an organism that conveys information to another individual, often eliciting a specific response.

32. **Polymorphism** The co-existence of two or more distinct and discontinuous morphological types in a species; e.g., the Common Mormon, in which the male occurs in one form but the female has three distinct forms, two of which mimic the Rose butterflies. Compare with Dimorphism.

33. **Polyphenism** The occurrence of distinct seasonal forms in a species. It is usually an environmentally induced genetic expression. It is represented by the dry and wet season forms in butterflies.

34. **Proboscis** (refer to the illustration on p. 9) A long, tube-like mouth part of an adult butterfly, which is used for sucking liquid food and coiled in front of the eyes when not in use.

35. **Pupa** (also Chrysalis; refer to the illustration on p. 9) The dormant stage in the life of a butterfly, between the caterpillar and adult stages, in which the tissues in the body are re-organized.

36. **Scales** The covering on the wings consisting of loose, detachable structures that give the butterfly its colours.

37. **Sex-pheromones** Pheromones accompanying sexual activity in animals. Also see Pheromones.

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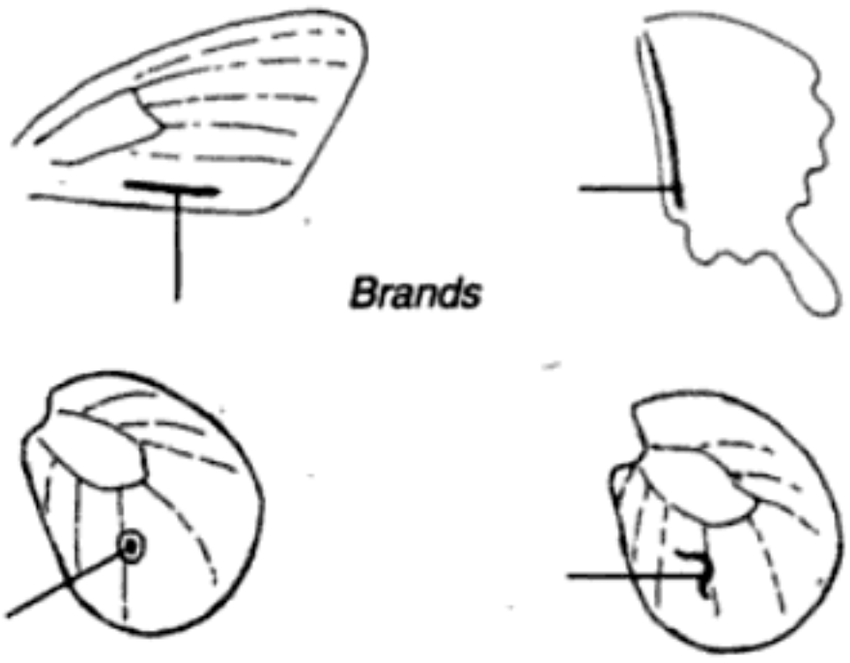
38. **Sexual brand** (also Brand) A patch of specialized scales, usually raised above the surface, of various shapes and sizes found on the wing of certain male butterflies, e.g., the Crows and Bushbrowns. The brand serves to attract female butterflies by the scent it produces. The brands may be present on the upper side or underside of the wings, usually near the wing margins.

39. **Sexual dimorphism** A sex-limited dimorphism in a species, where the sexes look different. Also see Dimorphism.

40. **Spiracle** (spiracular) (refer to the illustrations on p. 9) An external respiratory opening in insects. In butterflies it is present on the 2nd segment as well as all segments from the 5th to the last segment, a pair on each segment on the sides. In the pupae of the Skippers, the pair on the 2nd segment is usually very large and raised above the surface.

41. **Sub-dorsal** (of markings on a caterpillar): The a region between the central line on the back and spiracles of the caterpillar.

42. **Sub-spiracular** (of lines or other markings on a caterpillar): Below the line of the spiracles.



Brands

43. **Termen** (terminal; of the wings) The outer margin of the wings of a butterfly.

44. **Thorax** The 2nd section of a butterfly's body, bearing the wings and legs.

45. **Tornus** The lower corner of the wing of a butterfly.

46. **Wet season form** A morphological form of a species produced in the wet season of the year. The wings of a butterfly in the Wet season form are usually darker, more richly marked, and smaller. Compare with the Dry season form and also see Polyphenism.

47. **Woodlouse** A small hard-shelled terrestrial relative of crabs, which feeds on rotten wood and rolls into a tight ball when threatened.

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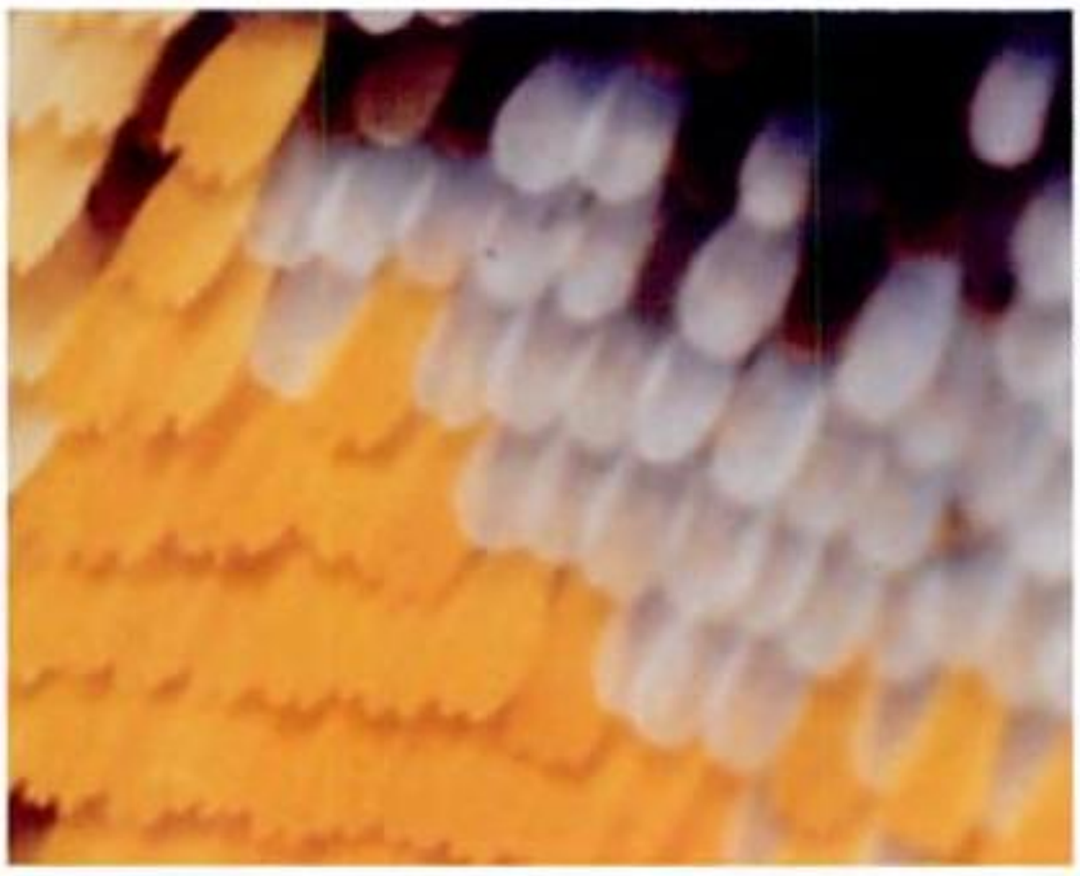
Plate 1: About Butterflies and Moths

Krushnamegh Kunte

1. Feathery antennae of male Atlas Moth (p. 4)

Krushnamegh Kunte

2. Stinging caterpillar of *Natada* sp. (moth) (p. 4)



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3. Scales on the wing of a butterfly (p. 1)

Krushnamegh Kunte

4. Scent scales of male Common Jay (p. 55)

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5. Hair pencils of male Dark Blue Tiger (p. 111)

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6. Mud-puddling butterflies (p. 23)

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13. Ants attending to Common Cerulean caterpillars (p. 43)

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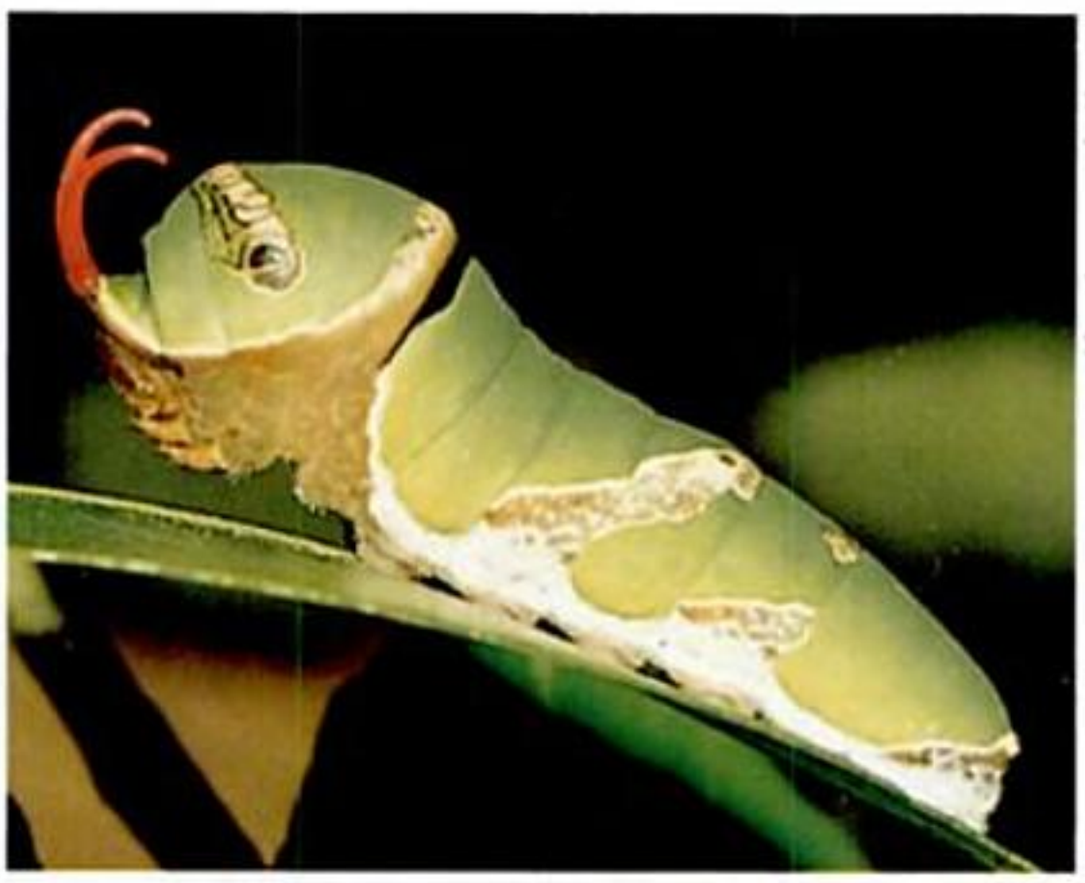
14. "Bird-dropping" stage of Common Mormon caterpillar (p. 56)



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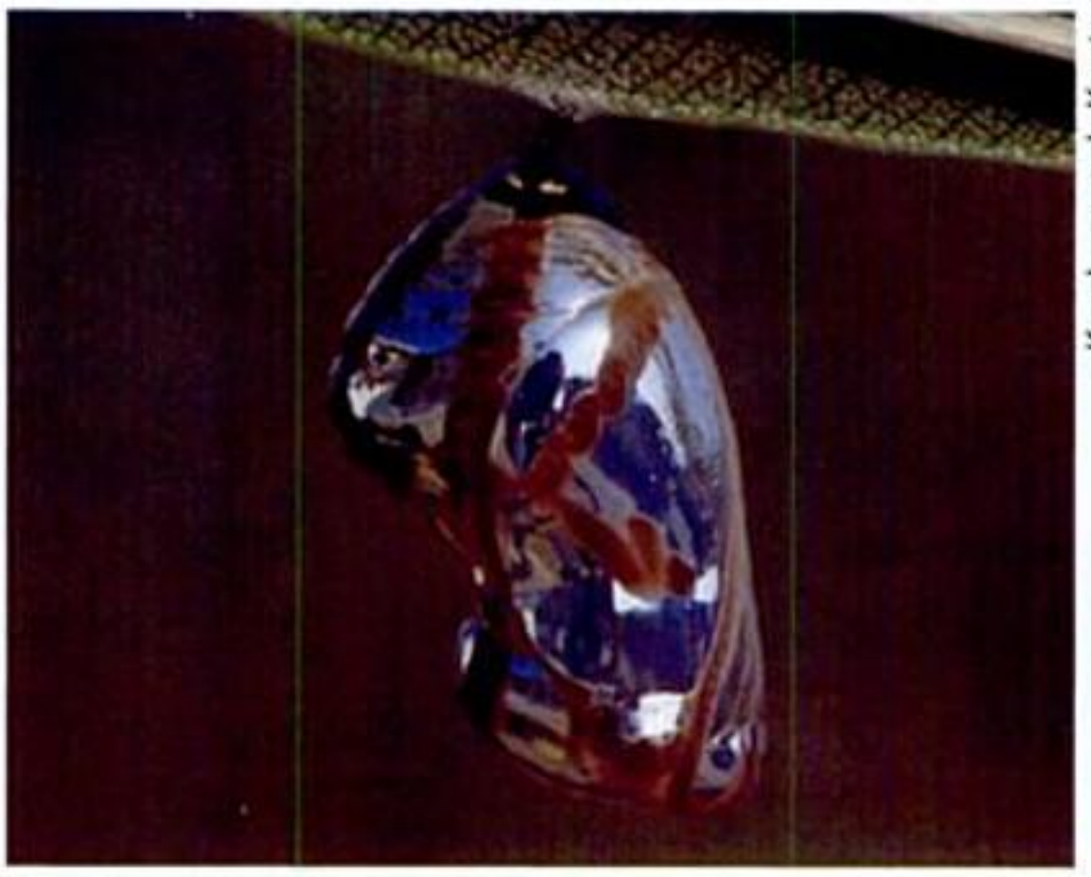
15. Common Mormon caterpillar with osmeterium exserted (p. 56)

Krushnamegh Kunte

16. Colourful caterpillar of unpalatable Common Indian Crow (p. 151 & 38)



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17. Bright golden pupa of Common Indian Crow (p. 151 & 38)

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18. Protectively coloured pupa of palatable Great Eggfly (p. 36)

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Plate 7: Metamorphosis of Danaid Eggfly Butterfly (p. 5)
Emergence

37. Butterfly opens the pupa like a door

38. Butterfly suspends itself to spread the wings

39. The wings slowly unfold . . .

40. The wings slowly unfold . . .

41. The wings slowly unfold

42. The Danaid Eggfly male is ready to take off

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Plate 8: Papilionidae: Swallowtails

E. Kunhikrishnan

43. Southern Birdwing (140–190 mm), male. p. 58

Krushnamegh Kunte

44. Common Rose (80–110 mm) p. 60

E. Kunhikrishnan

45. Common Mormon (90–100 mm), female, *stichius* form. p. 73

S. Karthikeyan

46. Crimson Rose (90–110 mm) p. 62

E. Kunhikrishnan

47. Common Mormon (90–100 mm), female, *romulus* form. p. 73

Krushnamegh Kunte

48. Common Bluebottle (80–90 mm) p. 63

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Plate 10: Papilionidae: Swallowtails and Pieridae: Whites and Yellows

E. Kunhikrishnan

55. Blue Mormon (120–150 mm) p. 76

S. Karthikeyan

56. Paris Peacock (90–140 mm) p. 77

E. Kunhikrishnan

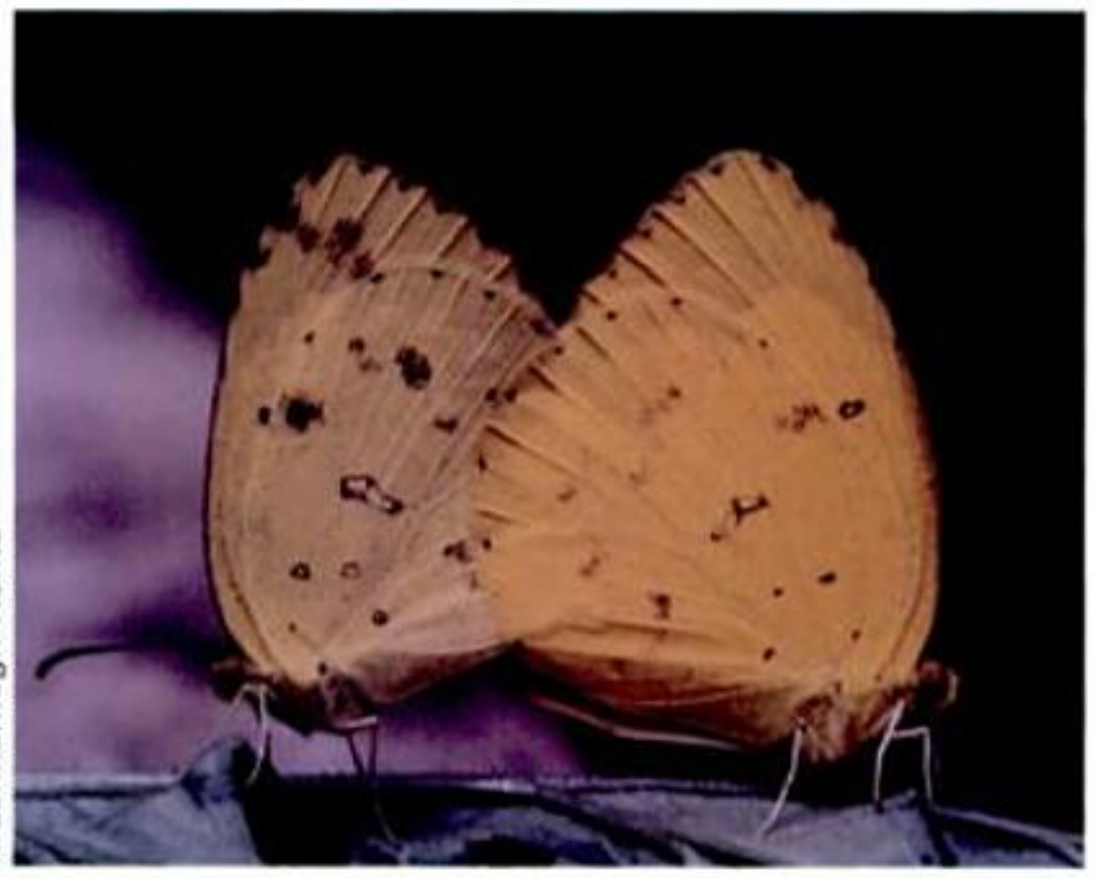
57. Malabar Banded Peacock (90–100 mm) p. 78

Krushnamegh Kunte

58. Common Emigrant (55–80 mm), male. p. 85

E. Kunhikrishnan

59. Mottled Emigrant (50–70 mm), male. p. 87



Krushnamegh Kunte

60. Common Grass Yellow (40–50 mm) p. 89

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Plate 11: Pieridae: Whites and Yellows

Krushnamegh Kunte

61. Spotless Grass Yellow (30–45 mm), dry season form. p. 89

E. Kunhikrishnan

62. Nilgiri Clouded Yellow (45–55 mm) p. 91

Krushnamegh Kunte

63. Common Jezebel (66–83 mm) p. 93

E. Kunhikrishnan

64. Psyche (35–50 mm) p. 94

S. Karthikeyan

65. Indian Cabbage White (45–60 mm) p. 95

Krushnamegh Kunte

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E. Kunhikrishnan

67. Pioneer (40–55 mm) p. 99

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68. Common Albatross (60–75 mm), male. p. 100

S. Karthikeyan

69. Plain Puffin (60–70 mm) p. 101

S. Karthikeyan

70. White Orange Tip (50–55 mm), female. p. 103

Isaac Kehimkar

71. White Orange Tip (50–55 mm), male. p. 103

Isaac Kehimkar

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E. Kunhikrishnan

73. Small Orange Tip (25–45 mm), male. p. 103

Krushnamegh Kunte

74. Crimson Tip (40–50 mm), female. p. 103

E. Kunhikrishnan

75. Great Orange Tip (80–100 mm), female. p. 103

S. Karthikeyan

76. Common Wanderer (65–80 mm), male. p. 105

K. A. Subramanian

77. Common Nawab (60–75 mm) p. 110

Krushnamegh Kunte

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S. Karthikeyan

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Niranjan Sant

80. Common Bushbrown (38–55 mm), wet season form. p. 114

Krushnamegh Kunte

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S. Karthikeyan

82. Whitebar Bushbrown (48–55 mm) p. 114

E. Kunhikrishnan

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E. Kunhikrishnan

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90. Rustic (50–60 mm) p. 121

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99. Commander (60–75 mm) p. 127

100. Clipper (105–125 mm) p. 128

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102. Common Baron (55–80 mm), male. p. 130

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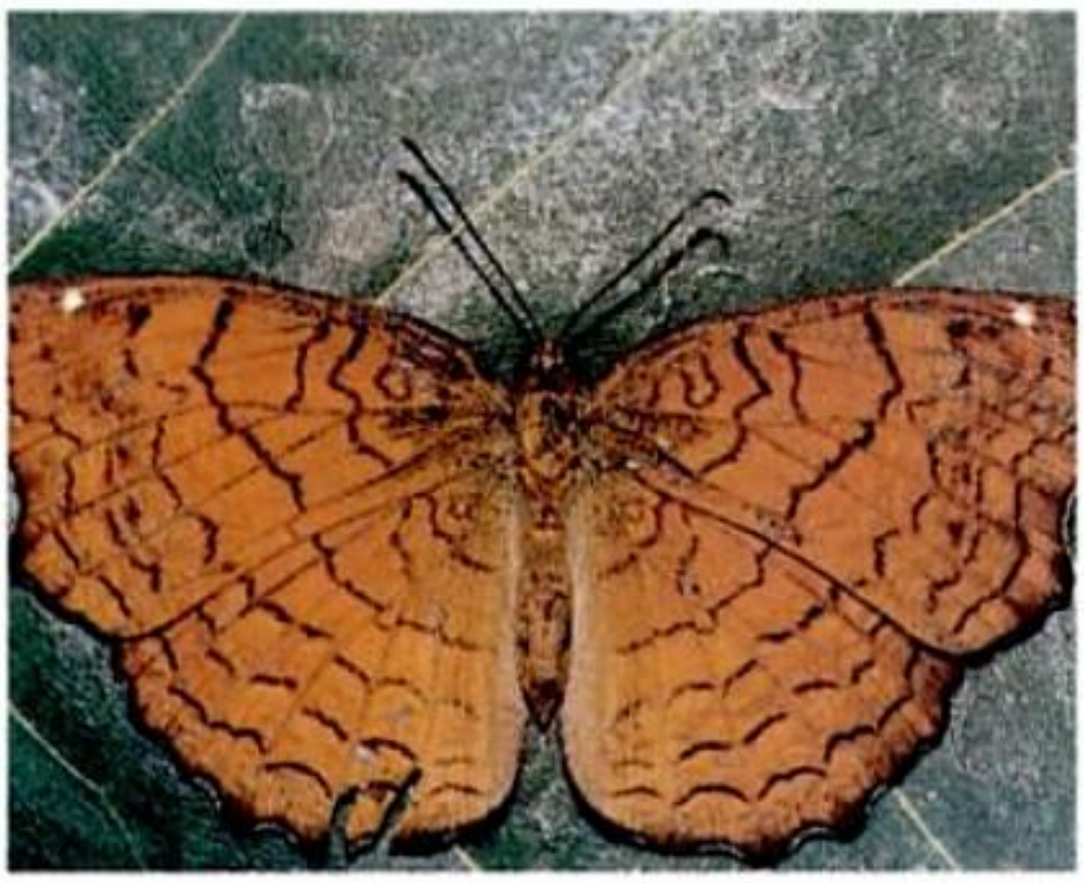
Krushnamegh Kunte

103. Common Baron (55–80 mm), female. p. 130

Sanjay Sondhi

104. Redspot Duke (93–110 mm), male. p. 131



Krushnamegh Kunte

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E. Kunhikrishnan

106. Common Castor (45–60 mm) p. 134

Krushnamegh Kunte

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E. Kunhikrishnan

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112. Chocolate Pansy (55–65 mm) p. 137

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E. Kunhikrishnan

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E. Kunhikrishnan

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S. Karthikeyan

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Ajit Jogalekar

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S. Karthikeyan

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Krushnamegh Kunte

120. Glassy Tiger (70–85 mm), male. p. 143

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K. A. Subramanian

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S. Karthikeyan

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Krushnamegh Kunte

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E. Kunhikrishnan

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S. Karthikeyan

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Krushnamegh Kunte

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Krushnamegh Kunte

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Krushnamegh Kunte

129. Great Eggfly (70–110 mm), female. p. 150

Sanjay Sondhi

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Krushnamegh Kunte

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Krushnamegh Kunte

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Niranjan Sant

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Krushnamegh Kunte

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Krushnamegh Kunte

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E. Kunhikrishnan

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E. Kunhikrishnan

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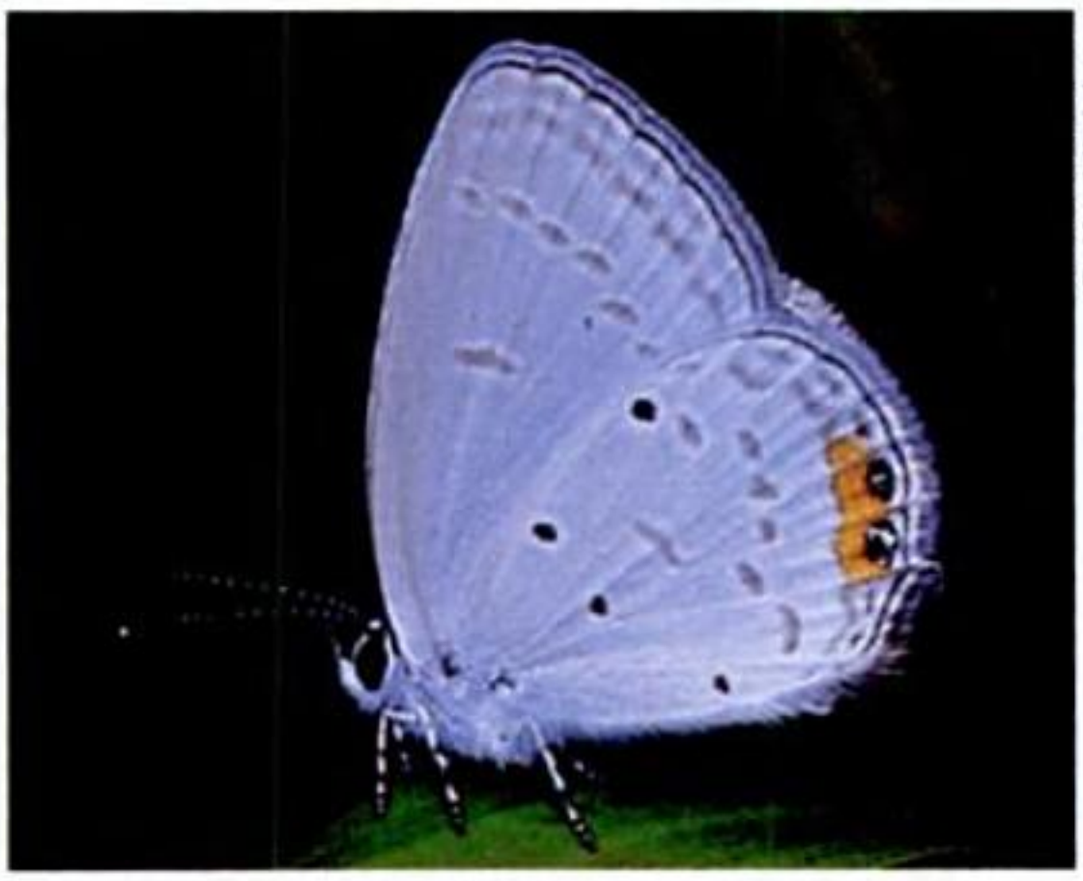

E. Kunhikrishnan

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Krushnamegh Kunte

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E. Kunhikrishnan

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Krushnamegh Kunte

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S. Karthikeyan

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Sanjay Sondhi

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Krushnamegh Kunte

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E. Kunhikrishnan

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E. Kunhikrishnan

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E. Kunhikrishnan

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S. Karthikeyan

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Isaac Kehimkar

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Isaac Kehimkar

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Krushnamegh Kunte

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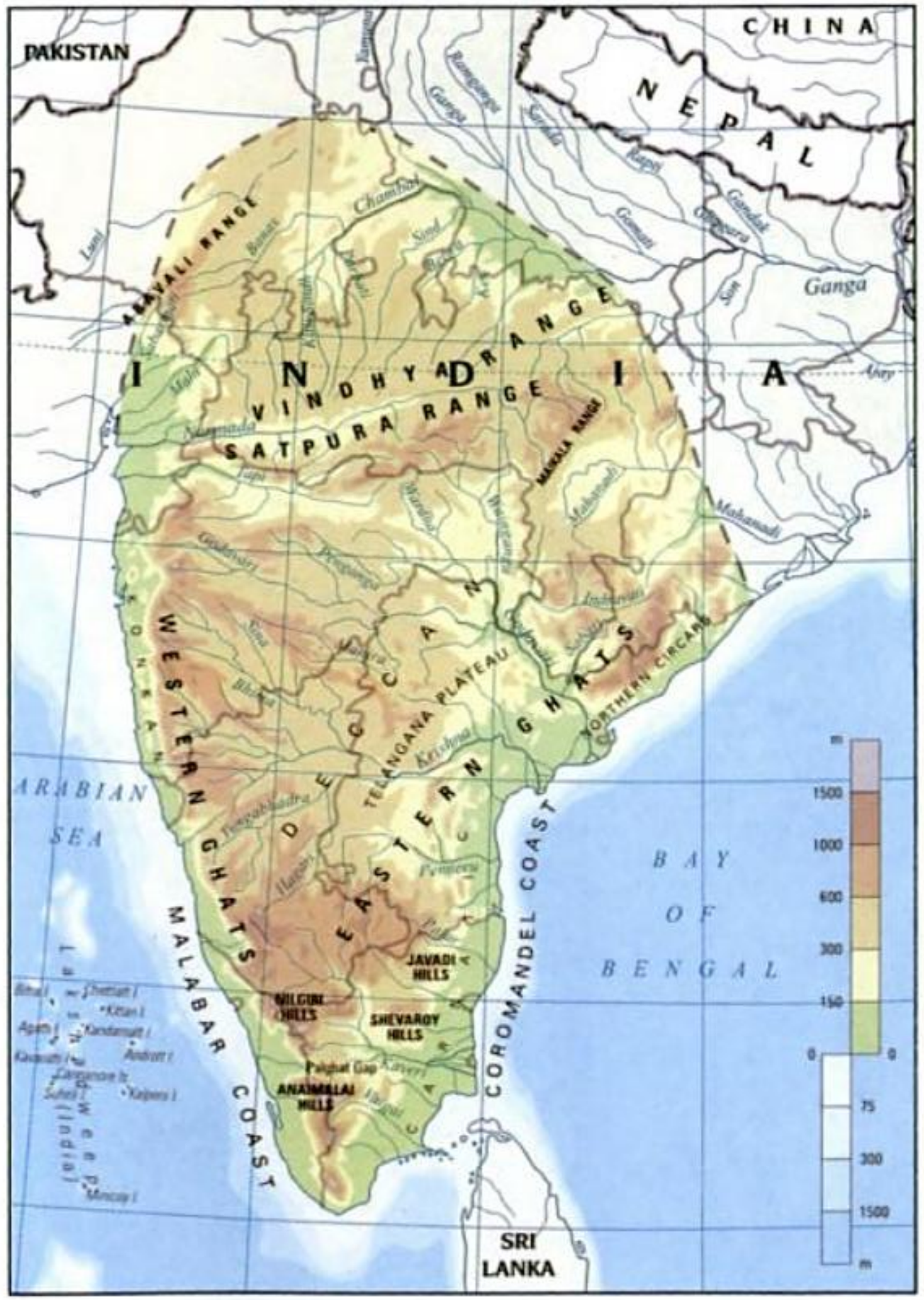

Plate 32a Limits of Peninsular India (as defined in this book)

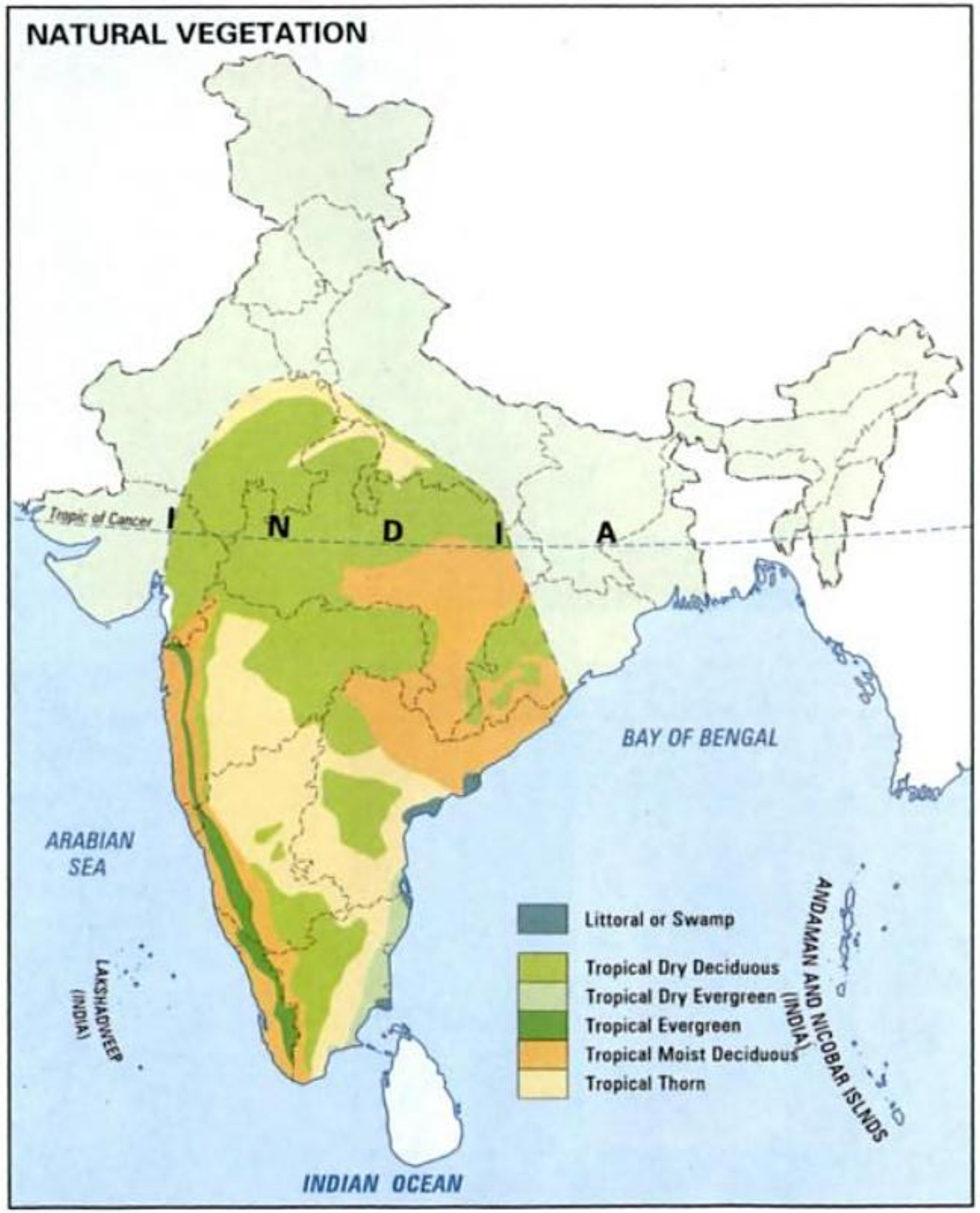

Plate 32b Natural Vegetation of Peninsular India

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Our roots are deep in the woods,
Among the mosses, close to the springs,
Our spirits soar high in the sky,
Among the birds and butterflies.

Madhav Gadgil,
after Emil Galle, c. 1884

This important new work of reference is also a joy to look at and a pleasure to read, combining comprehensiveness, consistency of style and beauty to this degree. *Butterflies of Peninsular India* represents the first fascicle in the series *PROJECT LIFESCAPE* which aims to cover illustrated accounts of 1,500 Indian species (and higher taxonomic categories such as orders and families) of micro-organisms, plants and animals. This series is meant to assist high-school, college and postgraduate students and teachers of biology in reliably identifying these taxa. Ancillary information on distribution, ecology and behaviour will help design field exercises and projects focussing on first-hand observations of living organisms. This essential source of visual and factual reference is an indispensable book for everyone who cares about nature, and will stimulate popular interest in the broader spectrum of India's biological wealth, much as Salim Ali's books have done for birdlife over the last fifty-eight years.

Krushnamegh Kunte, the author, is an up-and-coming field biologist interested in butterflies, frogs, birds and flowering plants. He has just completed an M Sc on the butterfly communities of the Anamalais from the Wildlife Institute of India, Dehra Dun.

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